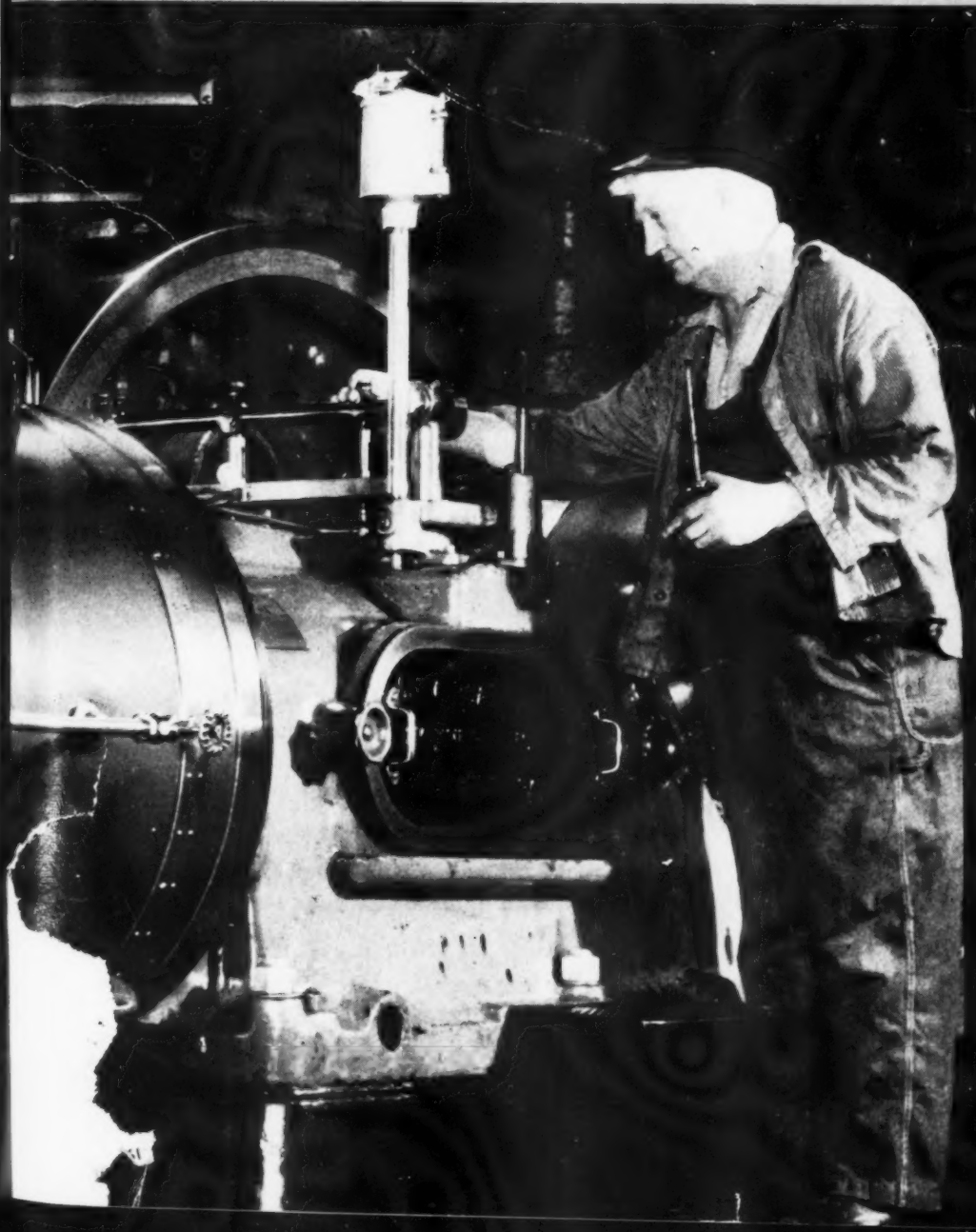
POWER

MAY, 1944

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRY



Today more than ever, power production for war depends on the skill and experience of veteran operating forces

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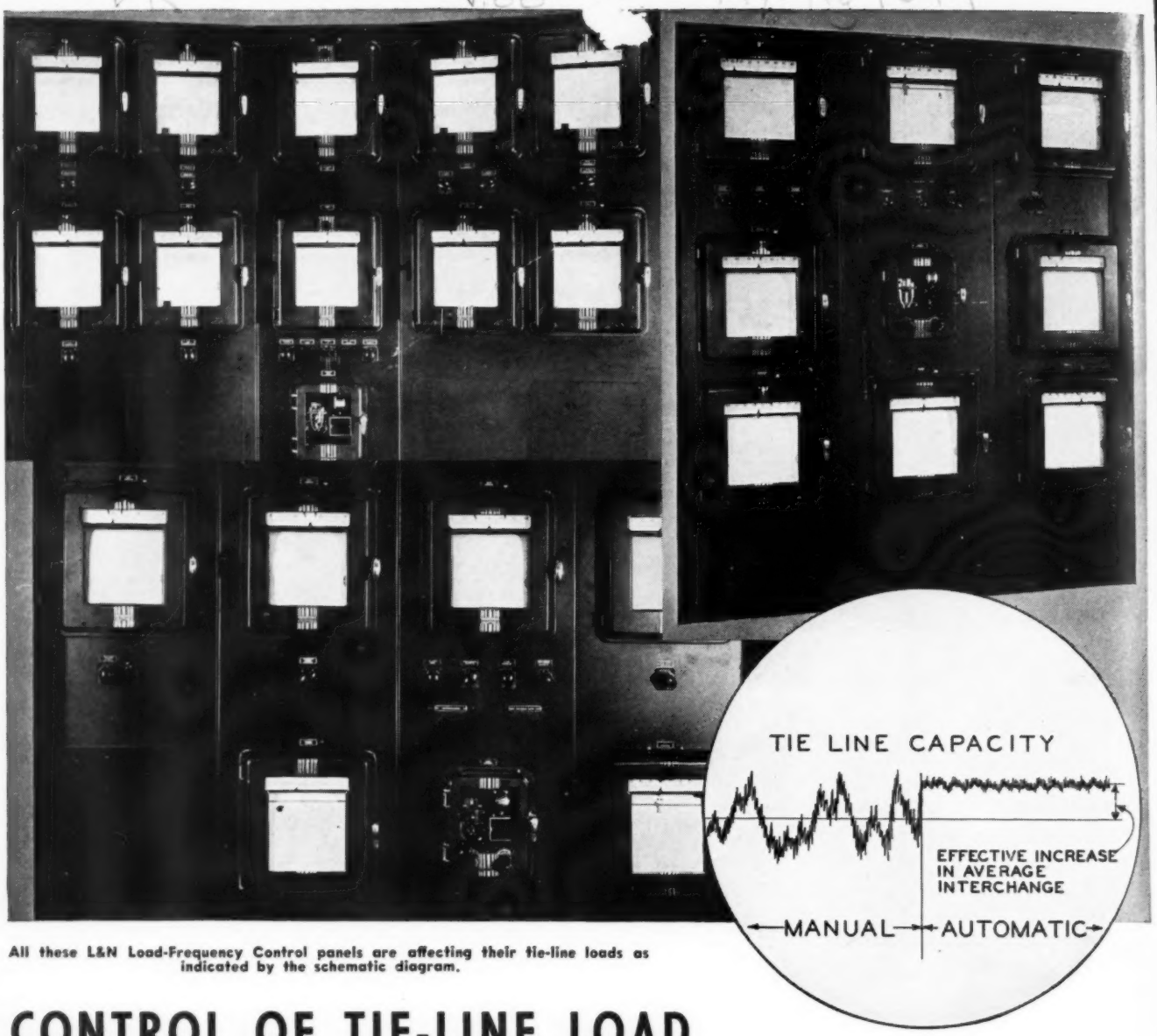
Page 59

Pooled power in Pacific Northwest saves installing 100,000 kw of new capacity. First-hand story tells how utilities, municipals and federal power sources have successfully pooled more than three million kilowatts. Page 68

One part in a billion — that's the accuracy approached by improved methods of oxygen measurement needed to check deaerator performance in today's high-pressure plants. Series of articles surveys procedures, outlines checks and precautions, and gives a completely detailed sample of a test. Part I begins on page 74

v.R v.88 2 May-Aug 1944



All these L&N Load-Frequency Control panels are affecting their tie-line loads as indicated by the schematic diagram.

CONTROL OF TIE-LINE LOAD IS LIKE "FINDING" A GENERATOR

The effective carrying capacity of a tie-line is increased, instantly and permanently, when the switches are thrown to turn load-frequency regulation over to the appropriate battery of L&N instruments.

There's no mystery about how the result is achieved; it's simply because all significant facts concerning interchanges and outputs are telemetered to the system-regulating point or points, where the fully-automatic instruments are fast, sensitive and accurate enough to execute the dispatchers' wishes more closely than men could execute them. The average of the tie-line load rises toward the line's capacity; the line carries more load; the effect is the same as though another generator has been found and put to work.

And this is not only in isolated cases; it is being attained in war-busy power centers all over the country.

We show above just a few of the panels we have recently supplied for this service; each designed after conference with the operating engineers concerned; each built to help that one network carry its load more effectively.

For a description of the equipments, see Technical Publicatio 161(1). For data on a specif lem, please write outlining t tion.

Jrl Ad

ARMY NAVY
depends on me!
A Slogan For Every American

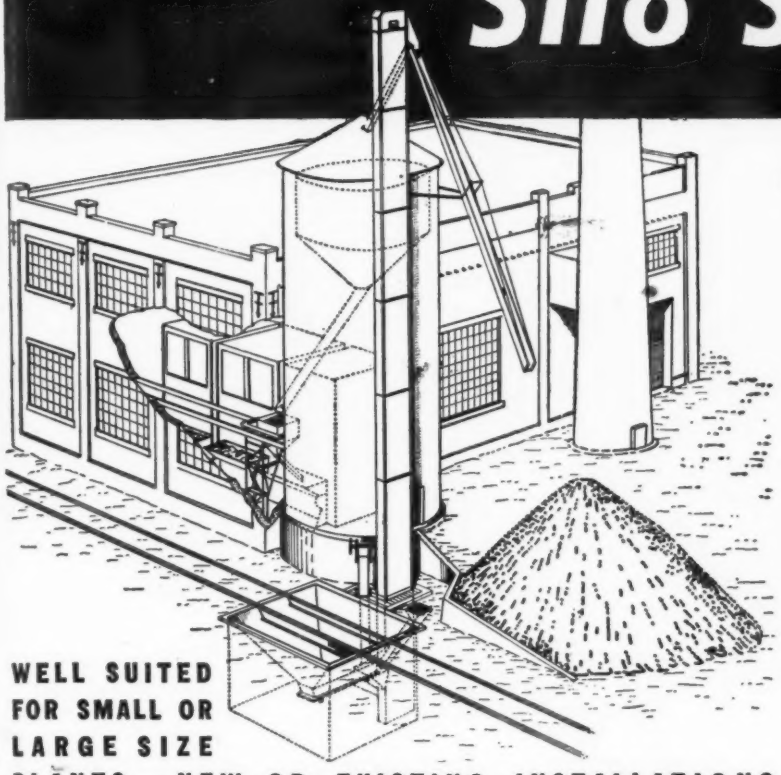
LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE.,
LEEDS & NORTH
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TR

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), No. 5 Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publication office, way, Albany 1, N. Y. Editorial and Executive Offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter, August N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about su addressed to the Director of Circulation, Power, 330 West 42nd Street, New York 18, N. Y. Subscription rates—U. S. and U. S. Poss year, $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions, 36 shillings per year. All for one year, $9.00 for two years. Single copies 35 cents.

TECHNOLOGY DEPT.

COAL AND ASHES HANDLING SIMPLIFIED WITH THE Silo System

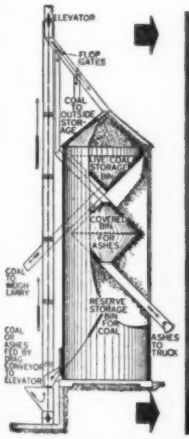
MAY 5 1944



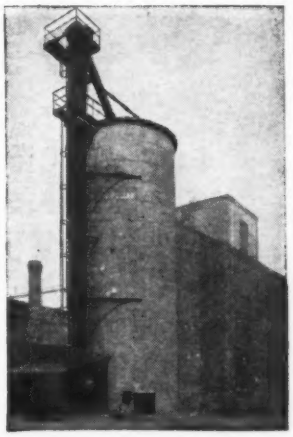
WELL SUITED FOR SMALL OR LARGE SIZE PLANTS — NEW OR EXISTING INSTALLATIONS

Combines Supply and Handling Functions in One Compact Economical Unit

Usually silos are located adjacent to the boiler house but constructed independently, and equipment within the boiler house consists entirely of means for distributing the coal. Frequently a single spout from the silo is all that is needed. Silos may be designed for normal storage requirements or equipped with an auxiliary spout to provide additional outside reserve storage when desired. This system may be arranged to store both coal and ashes. The installation shown above handles coal only, supplying the boiler house from active and reserve storage within the silo and storing out additional reserve ground storage. A traveling weigh larry receives coal from the live storage hopper of the silo and distributes it to the stokers. Talk over your problems with our experienced engineers.


ELEVATOR
FLOP GATES
COAL TO OUTSIDE STORAGE
LIVE COAL STORAGE BIN
COVERED BIN FOR ASHES
COAL TO WEIGH LARRY
RESERVE STORAGE BIN FOR COAL
ASHES TO TRUCK
COAL OR ASHES FED BY BELT CONVEYOR OR ELEVATOR

Both coal and ashes are handled here. Coal may be diverted to ground storage through an auxiliary spout. Ashes are discharged to the ashes section of the silo by means of a control gate and independent spout.



Another typical silo installation handling coal only, but without auxiliary ground storage. Coal from the live storage hopper in the silo is spouted directly to pulverizers located inside the building.

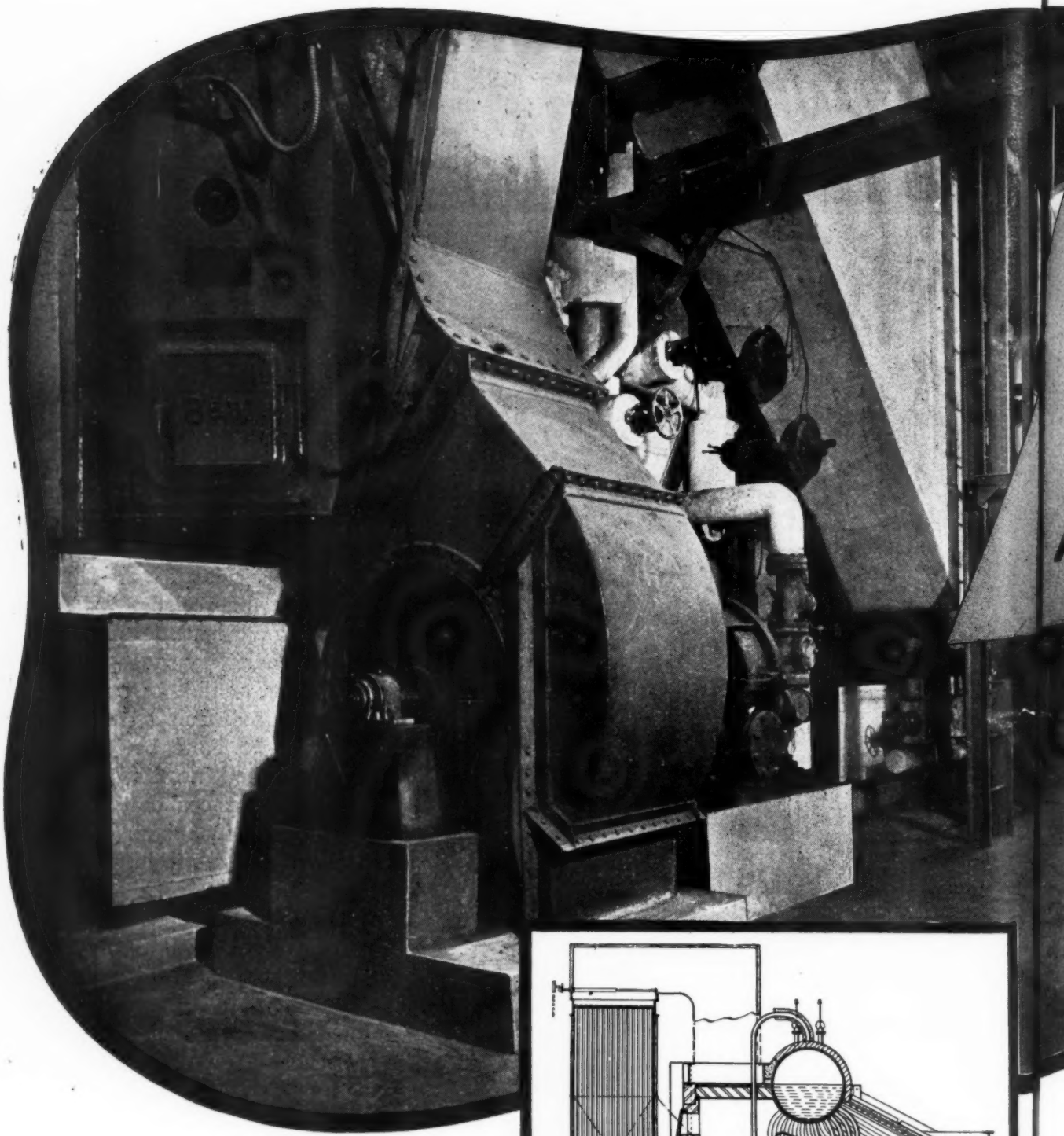
LINK-BELT COMPANY

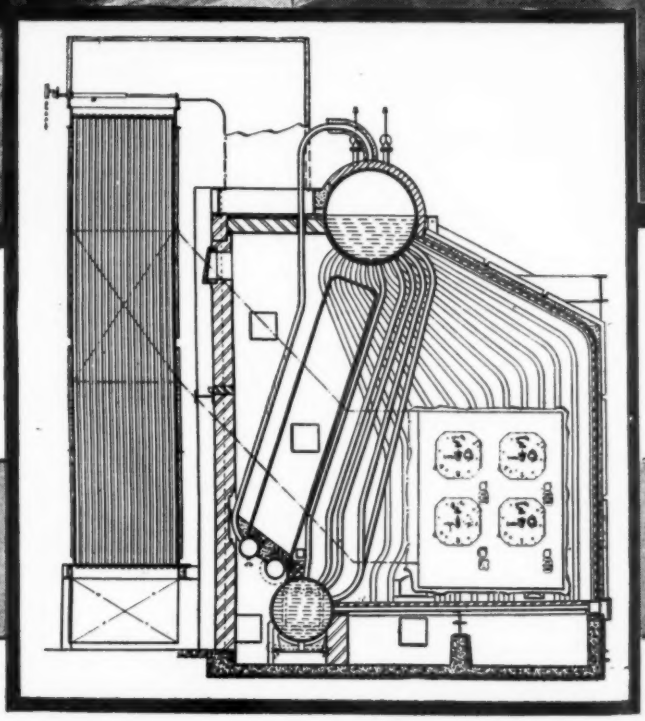
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Toronto 8.
Offices, warehouses and distributors in principal cities.
9190-A

LINK-BELT

. . . Coal And Ashes Handling Equipment

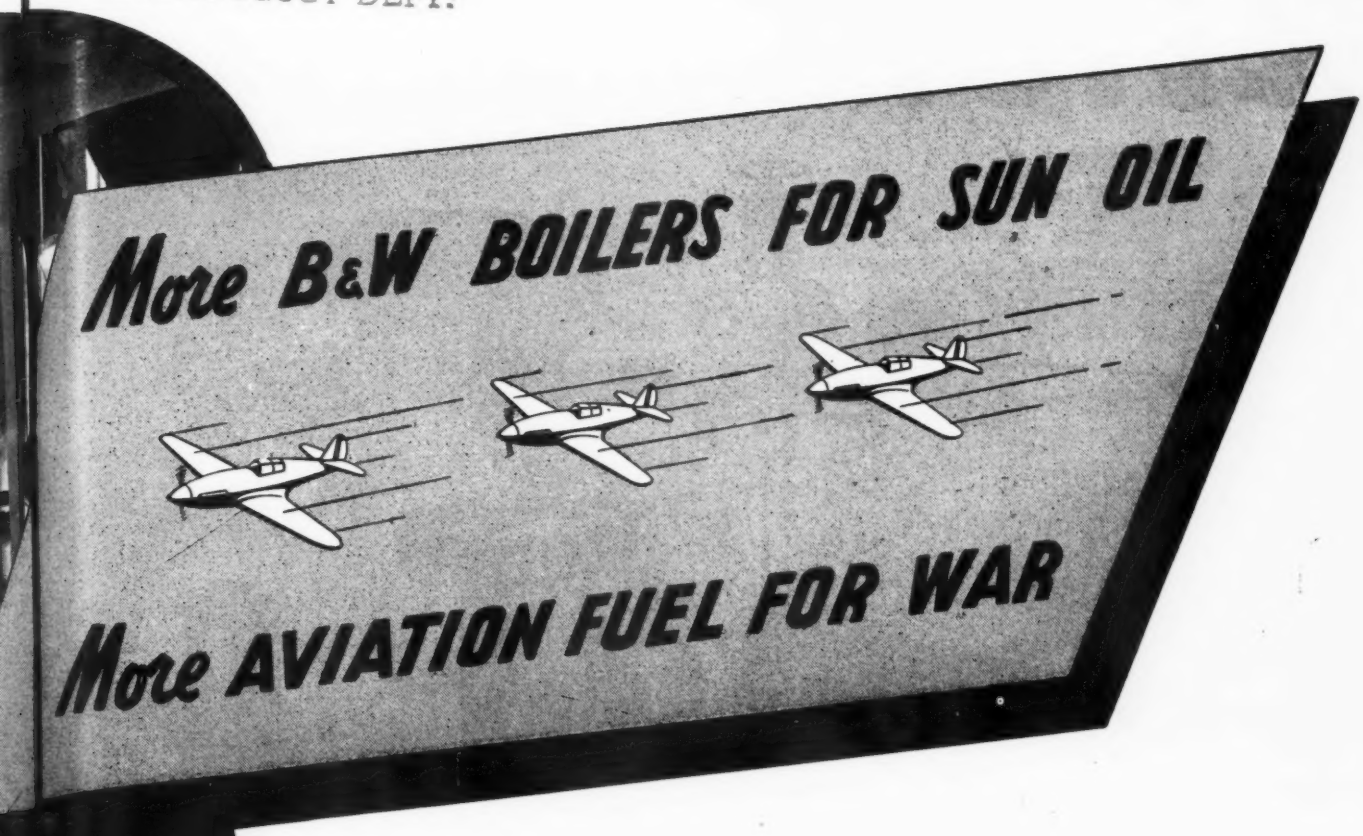
CONVEYORS • ELEVATORS • SKIP HOISTS • CRUSHERS • LARRIES • SCREENS





The Integral-Furnace Boilers have a capacity of 75,000 lb. steam per hr. each at 500 Psi and 750 F. They are fired with oil and gas.

TECHNOLOGY DEPT.



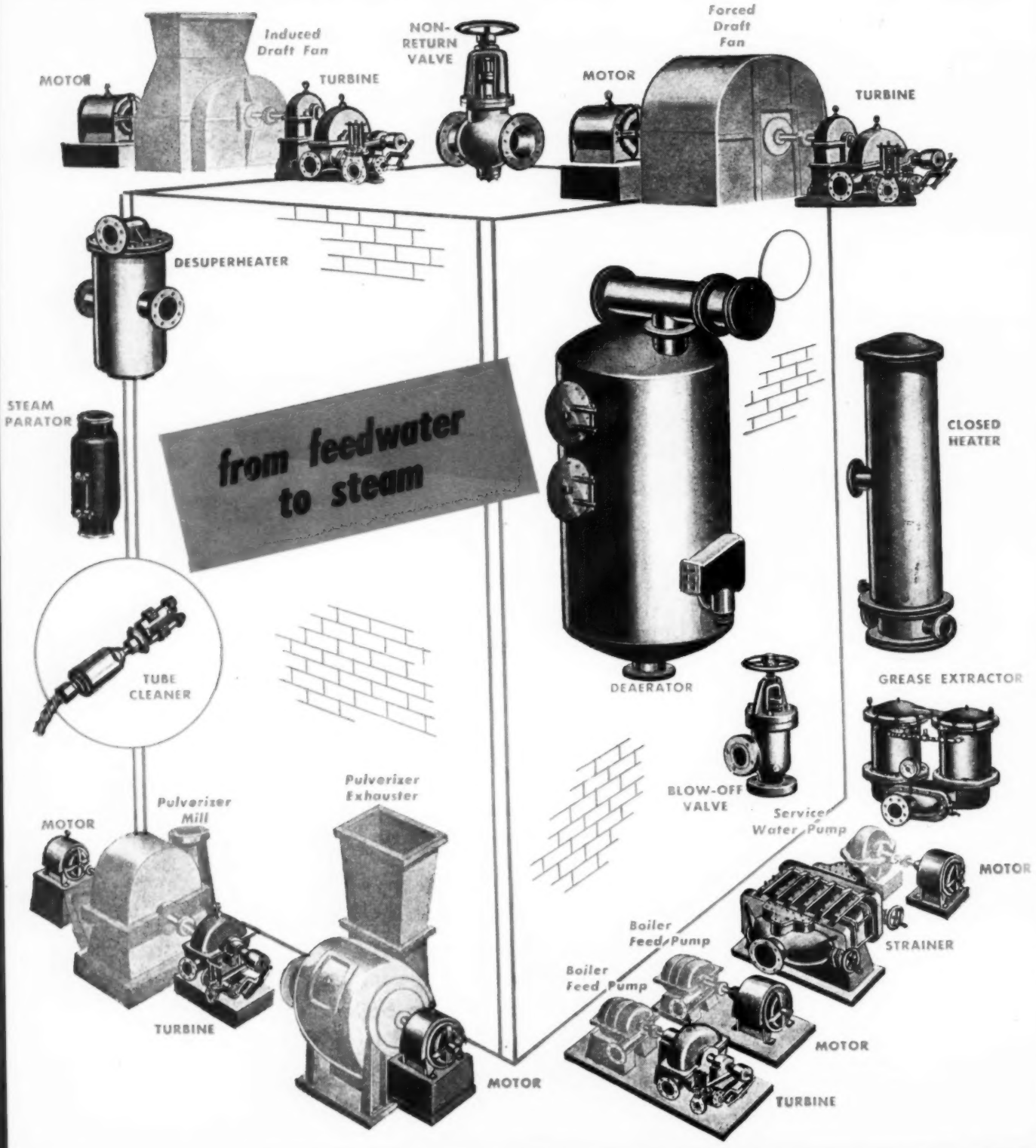
Record, war-shortening production of 100-octane aviation gasoline is expected of Sun Oil Company's new Marcus Hook refinery — one of the world's larger plants. Naturally, uninterrupted output of this vital ingredient of victory, calls for a dependable supply of power and process steam. In order to assure such a supply, three B&W Integral-Furnace Boilers were installed.

Experience with a similar B&W boiler installation at another Sun Oil boiler room at Marcus Hook since 1939 clearly demonstrated the reliability of the B&W Integral-Furnace Boiler for these new requirements. Further evidence of Sun Oil's confidence in these boilers is the fact that a fourth unit of the same type will be later added to the present Marcus Hook installation.

BABCOCK & WILCOX

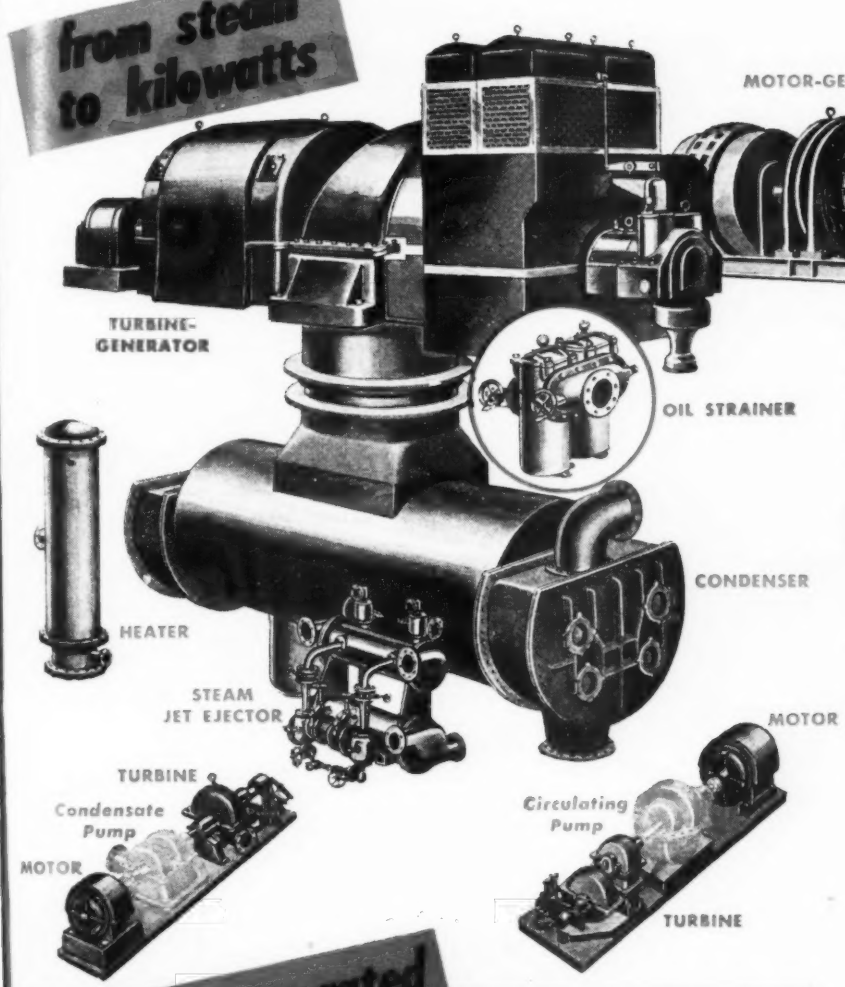
THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET NEW YORK 6, N. Y. G-265T

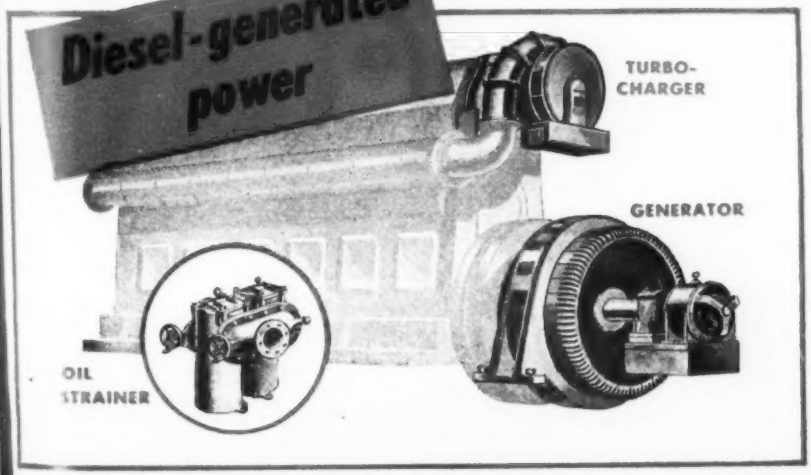
ELLIOTT -- from boiler



ELLIOTT

feed to generated power





On these two pages we picturize the varied equipment essential to put power-on-the-line. There's a lot of it — and a surprisingly large number of these units, (shown in full tone) is being built by Elliott Company.

Some of this equipment, the smaller units particularly, is pretty well standardized, being built on Elliott designs developed through years of practical service. Some, however, such as turbines, generators, larger motors, etc., are designed and built for the specific conditions under which they must operate. How well these conditions are met is attested by the confidence of power plant engineers in equipment with the Elliott mark.

There is nothing dramatic about dependable operation. But there *is* continuous and predetermined profit. That is the element which dominates in all Elliott equipment.

ARMY "E" NAVY ARMY "E" NAVY

Q-1107

Company

DISTRICT OFFICES IN PRINCIPAL CITIES

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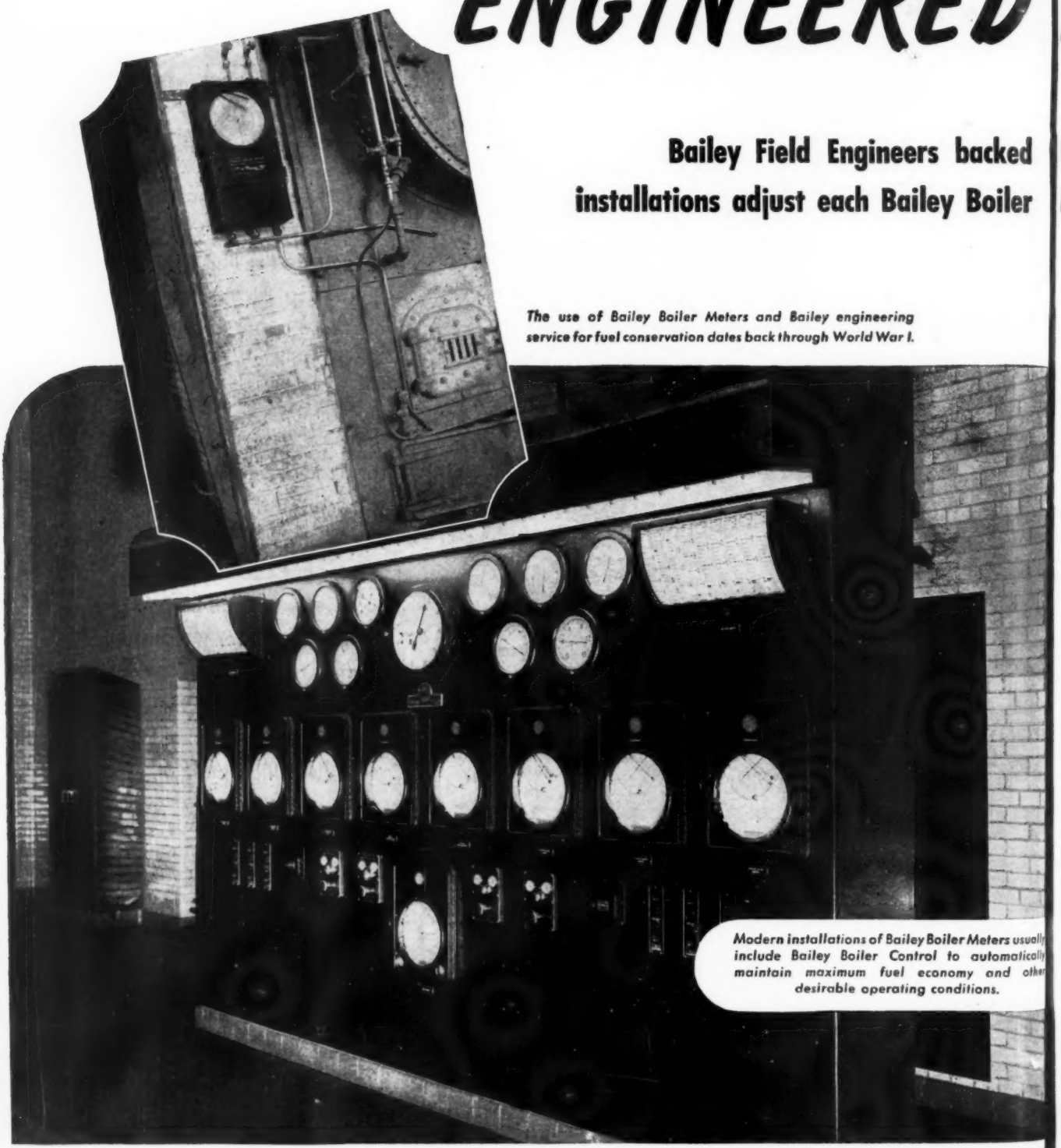
BAILEY BOILER METERS

ENGINEERED

Bailey Field Engineers backed installations adjust each Bailey Boiler



The use of Bailey Boiler Meters and Bailey engineering service for fuel conservation dates back through World War I.

Modern installations of Bailey Boiler Meters usually include Bailey Boiler Control to automatically maintain maximum fuel economy and other desirable operating conditions.

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHE

—YOUR PASSPORT to FUEL CONSERVATION

by the know-how gained from thousands of successful Steam Flow—Air Flow Meter to the particular requirements of the unit which it serves. The meter then serves as a guide to firemen in obtaining maximum fuel conservation in everyday operation.

Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Much of this engineering work is done in the user's plant by Bailey Field Engineers who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has "know-how" at his command which was developed by over 25 years experience with the Steam Flow—Air Flow method of combustion control. This includes the records of tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel burning equipment. You will find that this engineer has more to offer than meters and controllers. He is primarily interested in helping you to secure maximum fuel conservation and other benefits which result from the intelligent use of correctly selected and properly applied instrumentation. G-21

BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

The Complete Combustion Control System

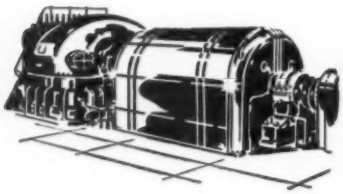
DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

ANNOUNCING

NEW GARGOYLE

—to meet today's most Severe of greatly increased Steam

PROVED FAR



Now in service in Turbines ranging in size from 1500 KW. to 50,000 KW.

THE TREMENDOUS PROGRESS made in steam turbine design has resulted in the use of greatly increased steam pressures and steam temperatures. This increased heat subjects turbine oil to severe oxidation conditions.

To meet these new, severe requirements, Socony-Vacuum has developed a brand-new turbine oil, a great addition to the famous Gargoyle D.T.E. Oil line.

The base stock of this oil is in itself a high-grade turbine oil having great resistance to oxidation. Further resistance to oxidation plus anti-rust qualities are added to this excellent turbine oil by special processing. The result is the ideal turbine oil, Gargoyle D.T.E. Oil 797.

This new oil has already proved its superiority. In gruelling tests it surpassed all leading turbine oils in resistance to oxidation.

This oil is in service in turbines ranging in size from 1500 KW. to 50,000 KW. Ask your Socony-Vacuum representative for details.

SOCONY-VACUUM OIL COMPANY, INC. • Standard Oil of N.Y. Division • White Star Division Lubrite Division Chicago Division • White Eagle Division • Wadhams Division Magnolia Petroleum Co. • General Petroleum Corp. of Cal.

FROM THE WORLD'S LEADER IN LUBRICATION:

D.T.E. OIL

Turbine Operating Conditions Pressures and Temperatures.

SUPERIOR!

WHAT MAKES A GREAT TURBINE OIL?

✓ ***Excellent Base Stock:*** The fundamental requirement for an ideal turbine oil is a base stock that in itself is an excellent turbine oil with excellent resistance to oxidation.

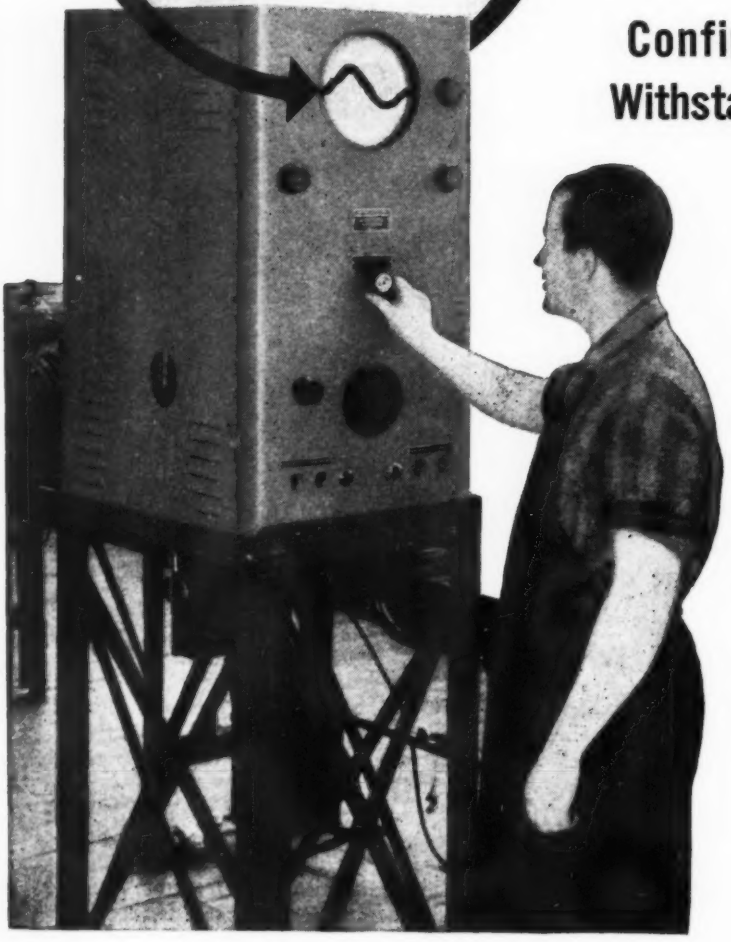
✓ ***Extra Resistance to Oxidation:*** Oxidation protection—PLUS—is needed to meet the effect of greatly increased temperatures in modern turbine operation. Your turbine oil should have this PLUS protection.

✓ ***Maximum Anti-Rust Qualities:*** The possibility of the presence of water demands that the oil should furnish maximum protection against corrosion. Your turbine oil should give this protection.

THE NEW GARGOYLE D.T.E. OIL 797 HAS ALL OF THESE NECESSARY CHARACTERISTICS

Socony-Vacuum Oil Company, Inc.

new... ELECTRONIC



Confirms Ability of Insulation to Withstand Shorts Due to Voltage Surges

● Now, a new electronic test shows *visually* that the insulation of every coil, every turn, and every phase of a G-E Tri-Clad motor winding has the strength to withstand the voltage surges that are a cause of shorts and grounds in service. Thanks to this new G-E development, no undisclosed insulation weakness can "get by."

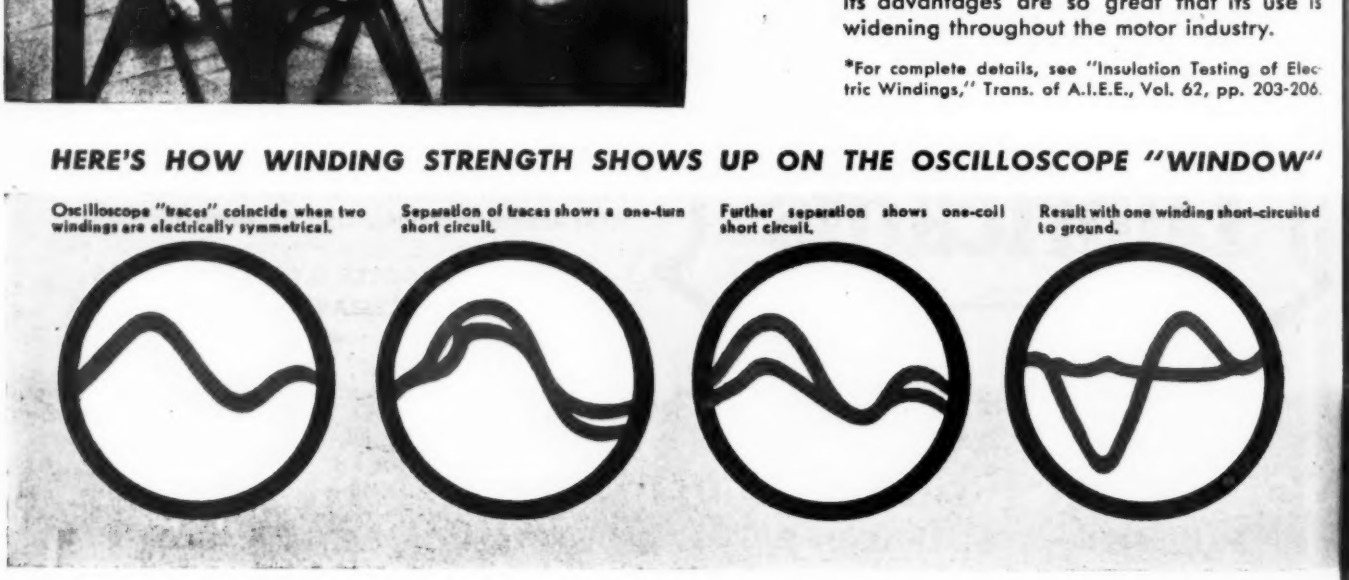
The new test method* subjects each coil in the assembled motor to a steep-front surge impulse, similar to a high-voltage transient of actual service. A cathode-ray oscilloscope indicates the performance of the winding under this sudden stress.

Only a motor with perfect insulation, and with the phases symmetrical, will give a single, clear-cut "standing wave" on the screen. The test indicates not only the condition of turn-to-turn insulation, but also that of coil-to-coil and coil-to-ground insulation.

This test is now applied to all G-E Tri-Clad motors, and to many other G-E motors and generators, as a regular step in production. Its advantages are so great that its use is widening throughout the motor industry.

*For complete details, see "Insulation Testing of Electric Windings," Trans. of A.I.E.E., Vol. 62, pp. 203-206.

HERE'S HOW WINDING STRENGTH SHOWS UP ON THE OSCILLOSCOPE "WINDOW"


Oscilloscope "traces" coincide when two windings are electrically symmetrical.
Separation of traces shows a one-turn short circuit.
Further separation shows one-coil short circuit.
Result with one winding short-circuited to ground.

TEST Tells the "Inside Story" of Motor Windings

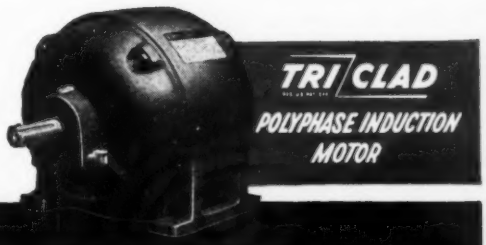
Production-line test of G-E Tri-Clad motors with new electronic tester. Operator turns transfer switch to take reading on each phase.

An Individual Check of Each TRI CLAD Motor Gives Extra Assurance of Unfailing Service

At each Tri-Clad motor factory, a production-line test setup like the one shown above is regularly in service. The motor windings are checked by this new test as an *additional* step in G.E.'s strict testing procedure. Other winding tests include the high-potential and high-frequency tests, in addition to many quality tests made on Formex* wire and other winding materials before they are used in the motor windings. Whenever you buy or specify a G-E Tri-Clad motor for your plant or machine, you get extra assurance of unfailing service. *General Electric Company, Schenectady, N. Y.*

*Reg. U. S. Pat. Office.

Every week 192,000 G-E employees buy more than a million dollars' worth of War Bonds.

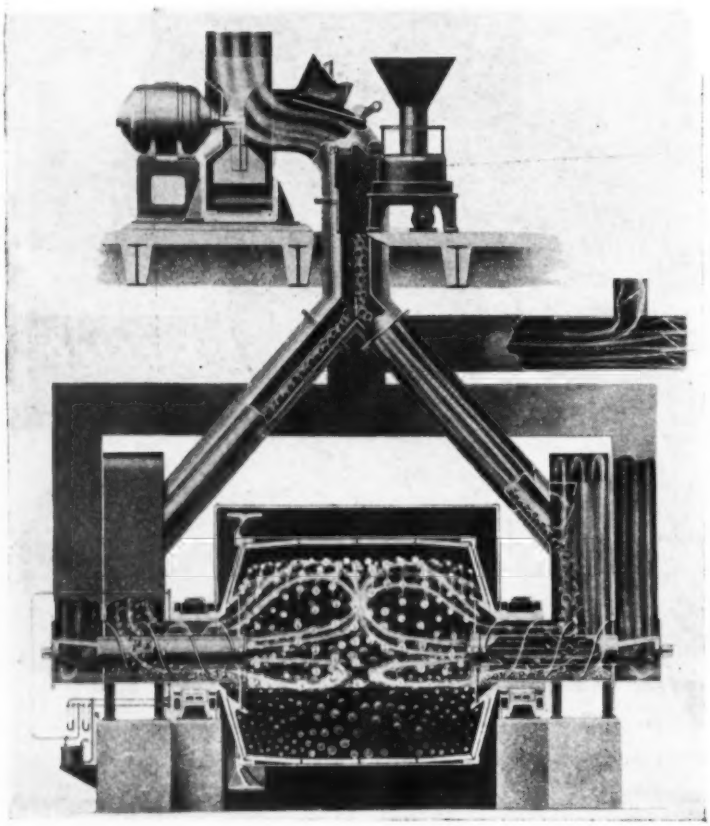


GENERAL ELECTRIC

Blazing THE Pulverized

Fuel Storage in Unit Systems

• When pulverized fuel was first commercialized, storage systems were provided for large installations to insure an ample available supply of pulverized fuel to meet sudden load swings. Unit systems were unsatisfactory as there was considerable lag between the time of change in feed rate to the mill and the change in amount of pulverized fuel available at the burner.



Development of the Foster Wheeler unit system incorporating the ball mill (Hardinge type) makes immediately available a six to eight minutes supply of pulverized fuel. This reservoir of prepared fuel is always maintained in the mill ready to meet additional demands of the boiler beyond the rate at which it is being operated. Rate of feed is governed by a controller which keeps a constant level of fuel in the mill.

Foster Wheeler is a Three-Star winner under the U.S. Navy Board of Awards for production.

FW FOSTER

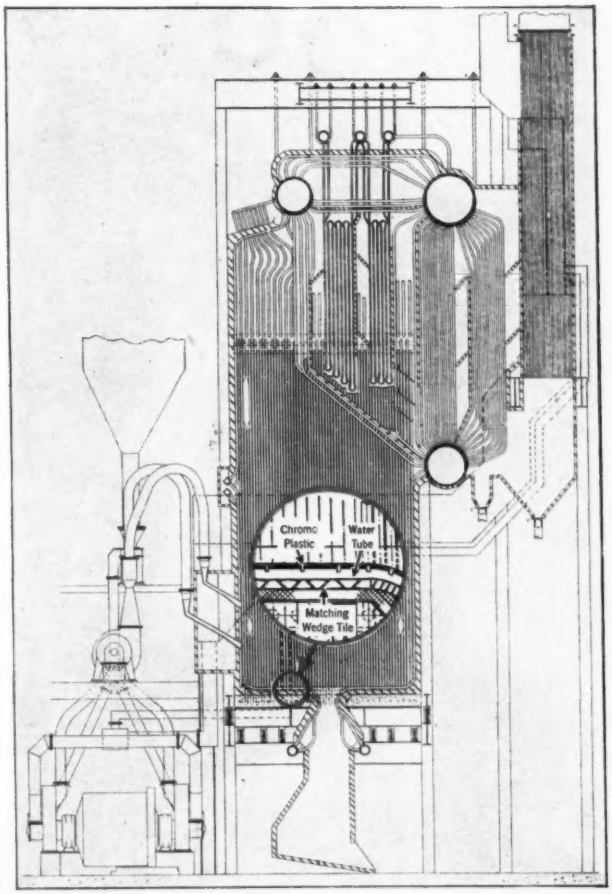
ENGINEERING TRAIL

Fuel Equipment

Flexible Floors for Slagging Furnaces

• The interlocking wedge tile construction for slagging furnace floors, originated by Foster Wheeler, has been highly successful for the past thirteen years.

The wedge tile design is used not only in continuous slag removal and intermittent slag tap furnaces, but also in both air and water cooled slagging furnace floors.



The advantages of this construction are:

1. **Expansion difficulties eliminated as horizontal expansion is transferred to vertical movement.**
2. **Continuous tightness.**
3. **Long life.**
4. **Negligible maintenance.**
5. **No outages due to furnace floors.**

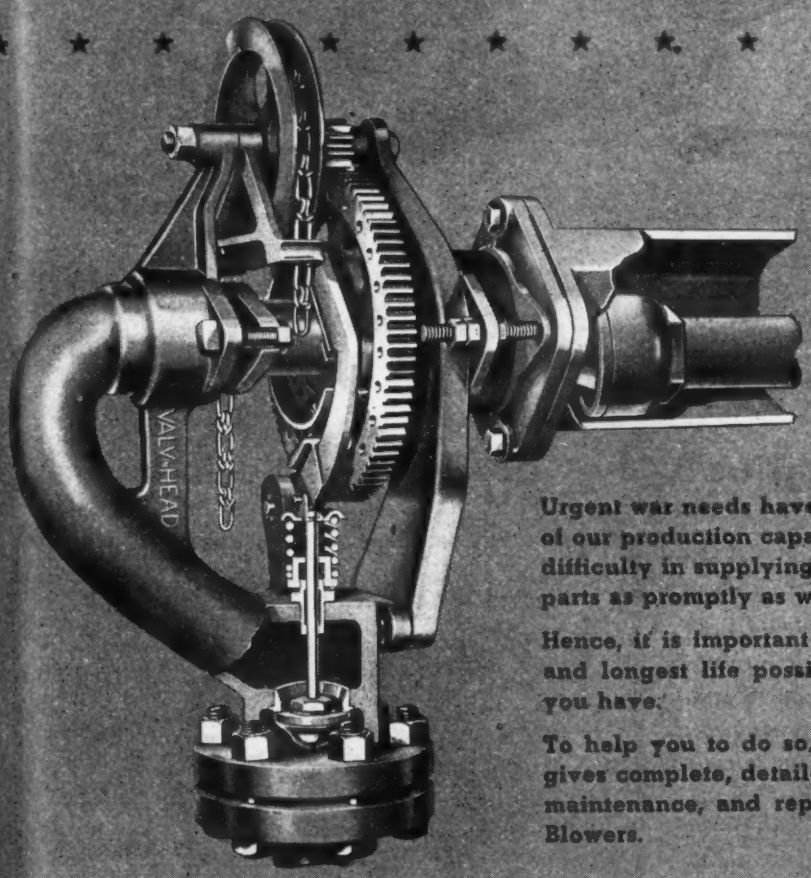
FOSTER WHEELER CORPORATION
165 BROADWAY
NEW YORK 6, N. Y.

WHEELER

This Book

VALV-IN-HEAD
Parts,
Maintenance,
and Operating
Instructions

Enables you to GET MORE out of your Soot Blowers



Urgent war needs have absorbed a large portion of our production capacity. We often have great difficulty in supplying new soot blowers or repair parts as promptly as we'd like.

Hence, it is important that you get the best use and longest life possible from the soot blowers you have.

To help you to do so, we offer this book which gives complete, detailed instructions on the care, maintenance, and repair of Diamond G9B Soot Blowers.

LET US SEND YOU A COPY—
WE THINK YOU WILL FIND IT USEFUL

THROW YOUR *Scrap* INTO THE FIGHT

DIAMOND POWER SPECIALTY CORP.
DETROIT, MICHIGAN

DIAMOND SPECIALTY LIMITED • Windsor, Ontario

DETROIT PUBLIC LIBRARY

FLAMENOL

Simple test demonstrates value of G-E synthetic cable

Before you install wiring in a location where there is danger of fire, *first* make this test:

Light a match, and hold a piece of Flamenol* wire in the flame. Use several matches, one after another. The insulation will char, but it will *not* burst into flame. Therefore, Flamenol gives you this assurance: If fire *does* break out, *it will not be spread by the wiring.*

Flamenol Has Proved Itself

The insulation on Flamenol wire and cable is *not* a newly developed and temporary substitute. Designed to overcome the disadvantages inherent in other insulations, it has been in commercial use more than *eight years.* Its many advantages, listed at right, have been proved under severe conditions of service in thousands of industrial installations.

As a result of thorough tests carried out over long periods of time, many of the country's leading chemical, oil, automotive, and other companies changed to Flamenol long before the rubber shortage. For further information, constructions, suggested uses, etc., write to the nearest G-E office. *General Electric Company, Schenectady, N. Y.*

*Reg. U.S. Pat. Off.

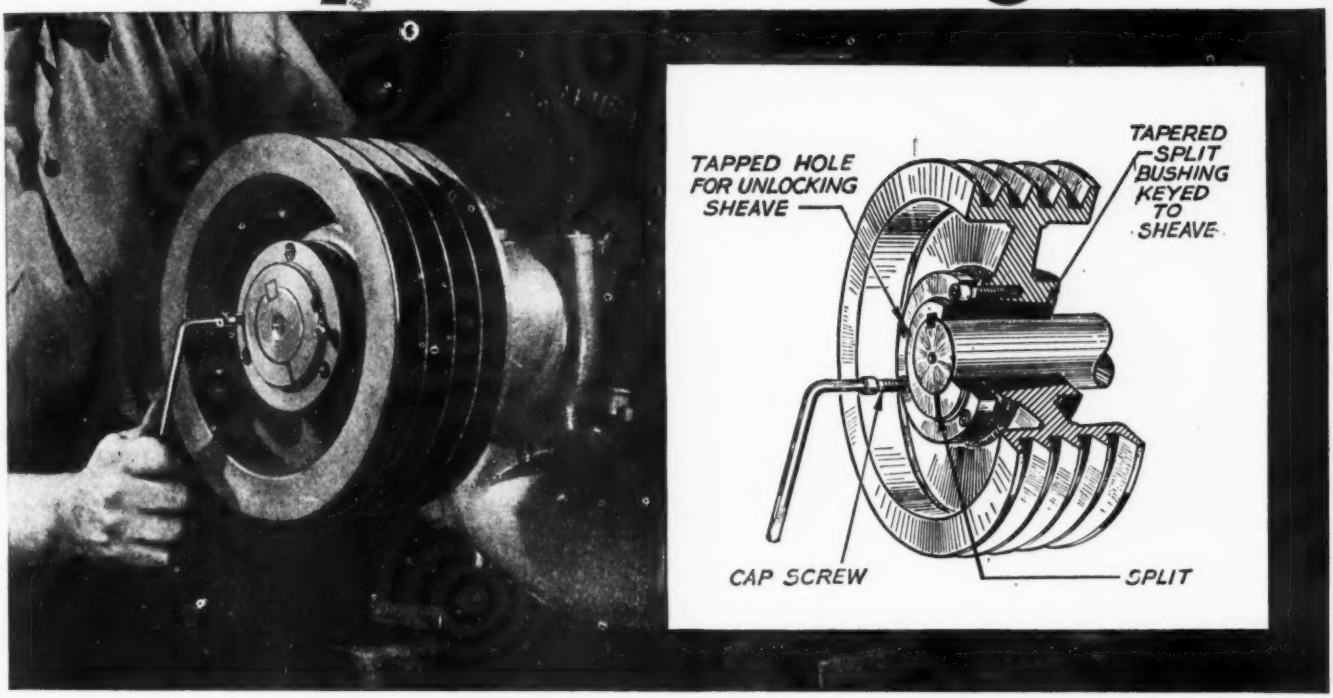
12 BIG ADVANTAGES offered by FLAMENOL

1. FLAME RESISTANCE—does not support combustion.
2. CORROSION RESISTANCE—immune to action of oils, acids, alkalies.
3. SUPER-AGING — does not oxidize. Highly resistant to sunlight and weathering.
4. EXCELLENT PHYSICAL PROPERTIES—has minimum tensile strength of 1500 lb per sq in., minimum elongation of 100 per cent.
5. DIELECTRIC STRENGTH — retained at about 720 volts per mil through severe operating conditions.
6. SMALL DIAMETER — saves space, facilitates wiring.
7. SMOOTH SURFACE—facilitates pulling through conduit.
8. FREE STRIPPING—speeds splicing, avoids nicking conductors.
9. DIFFERENT COLORS—simplify circuit tracing.
10. VARIOUS CONSTRUCTIONS—aid selection for special applications.
11. SELF-PROTECTING FINISH — eliminates need for braid, less space required.
12. ATTRACTIVE APPEARANCE—is maintained through long service, painting is never needed.

BUY WAR BONDS

GENERAL ELECTRIC

It's Smoother Running because it "Grips like Magic!"



...And it's the fastest mounting sheave on the market—goes on with one easy locking operation—saving man-hours and money.

POSITIVE clamp fit of Allis-Chalmers' great new "Magic-Grip" sheave means shafts are gripped tightly and uniformly...eliminating wobble and shear!

Its tapered split bushing makes it possible for anyone to mount or remove sheave quickly and easily — an important worker-safety feature. Accommodating normal shaft tolerances, the sheave that "grips like magic" may be changed often without injury to shaft.

And you get the great new "Magic-Grip" sheave... *at no increase in price!* Now, more than ever, it pays to make Allis-Chalmers your "V-Belt Headquarters."

For complete information, ask our nearest district office or Texrope dealer for Bulletin B6310. Or write ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1681

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

HIGH BOILER EFFICIENCY DESPITE SUDDEN LOAD CHANGES

DETROIT ROTOGRATE STOKER

AT THE

FALK CORPORATION

MILWAUKEE, WISCONSIN

The Falk Corporation are makers of the widely known Falk "Steelflex" coupling. Also, they build main propulsion reduction gear drives for all classes of vessels and other war products.

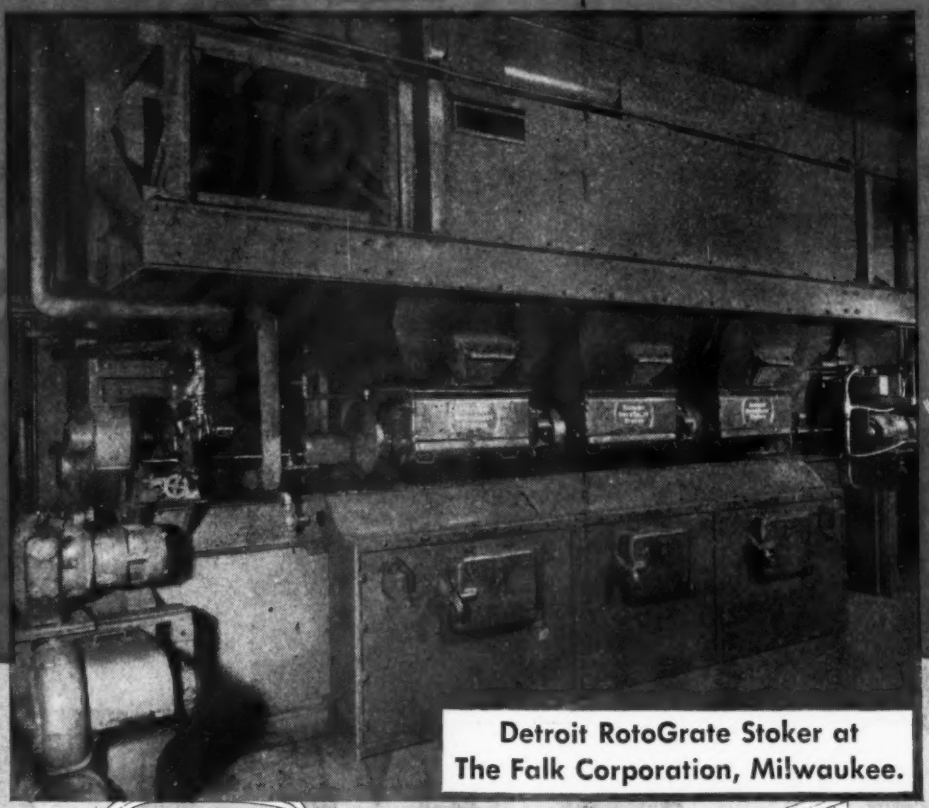
Detroit RotoGrate Stoker at The Falk Corporation is operated consistently at 14½% CO_2. The average monthly efficiency is 83.13%. Uniform steam pressure is maintained in spite of load changes from 50,000 to 77,000 pounds of steam per hour that occur when testing the reduction gears manufactured by them.

The RotoGrate is a CONTINUOUSLY CLEANING Spreader Stoker. The revolving Rotors distribute the coal uniformly in the furnace because they operate with an OVERTHROW ACTION. The fine particles of fuel are burned in suspension and the coarse coal on the grates.

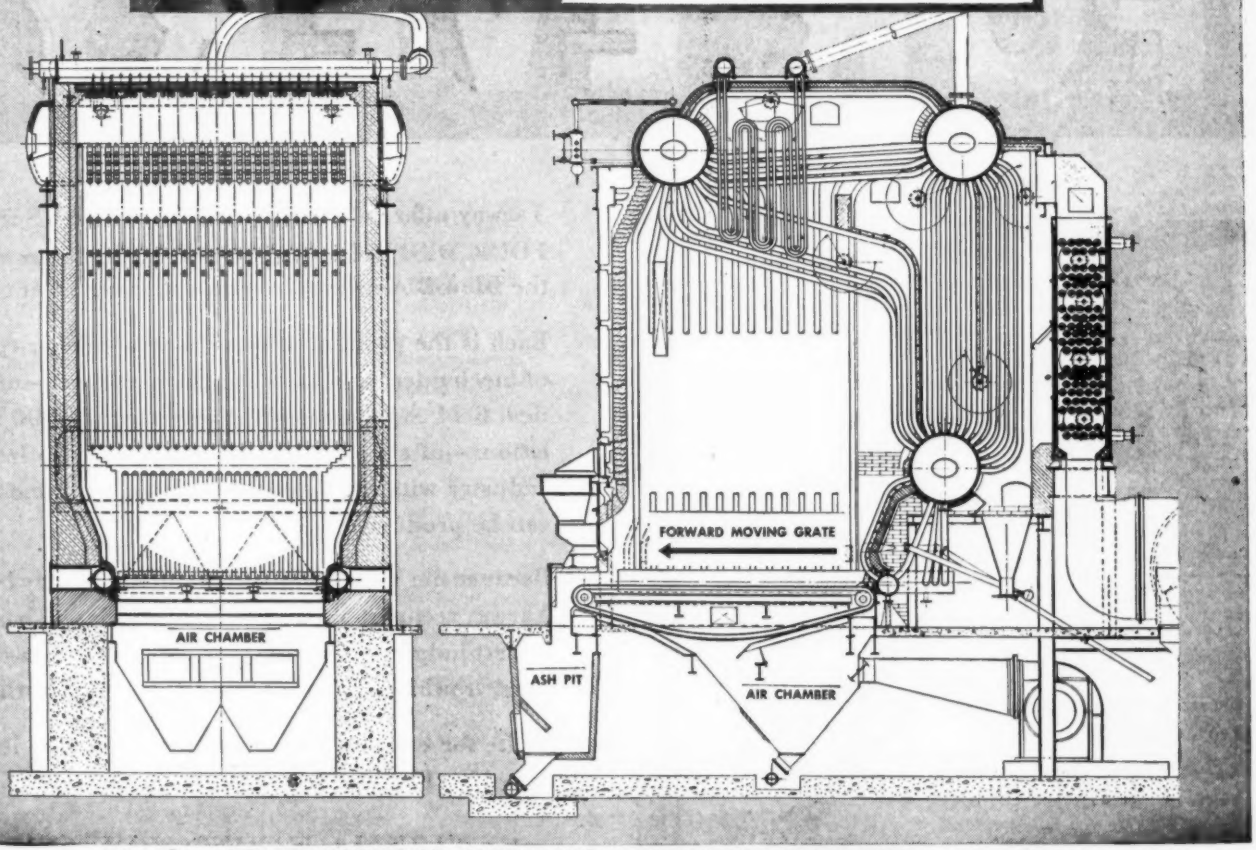
A thick layer of ash protects the grates from the thin but uniform bed of fire, above. The ash is automatically discharged at the front end by the slow continuously FORWARD MOVING GRATE.

The RotoGrate may be the answer to your combustion problem. It provides a successful method for burning an extremely wide range of fuels. Write for catalog.

DETROIT STOKER COMPANY



Detroit RotoGrate Stoker at
The Falk Corporation, Milwaukee.



It's the CONTINUOUSLY CLEANING FORWARD MOVING grate that permits higher burning rates with fuels of either high or low ash content.

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

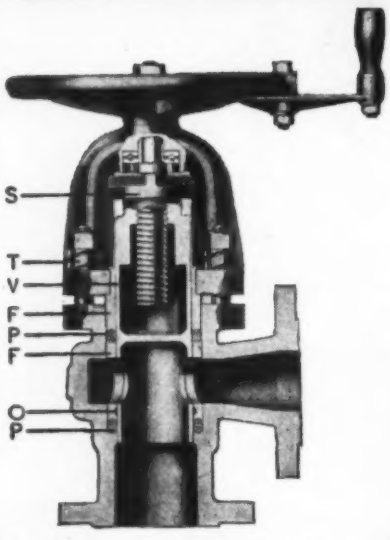
Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

BLOW-OFF

At left, Yarway Seatless and Double-Tightening Valves in Tandem, for pressures up to 250 lb

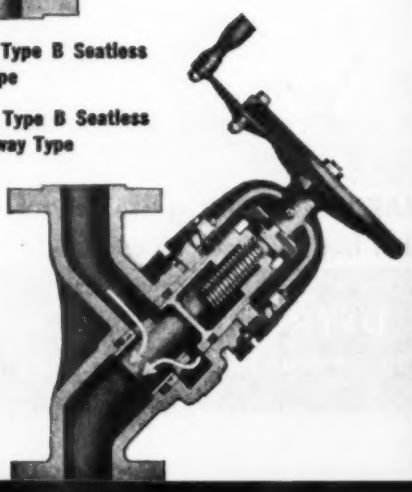
At right, Yarway Seatless Tandem for pressures up to 400 lb

FOR EVERY



1. Above: Yarway Type B Seatless Valve, Angle Type

2. Below: Yarway Type B Seatless Valve, Straightway Type



Yarway offers a complete Blow-Off Valve Service—FOUR DISTINCT TYPES OF VALVES to answer the Blow-Down Requirements of every steam plant.

Each is the product of more than a quarter-century of mechanical and metallurgical research—of practical field experience with more than 12,000 installations—of a determination continually to lead the Industry with the finest blow-down equipment that can be produced.

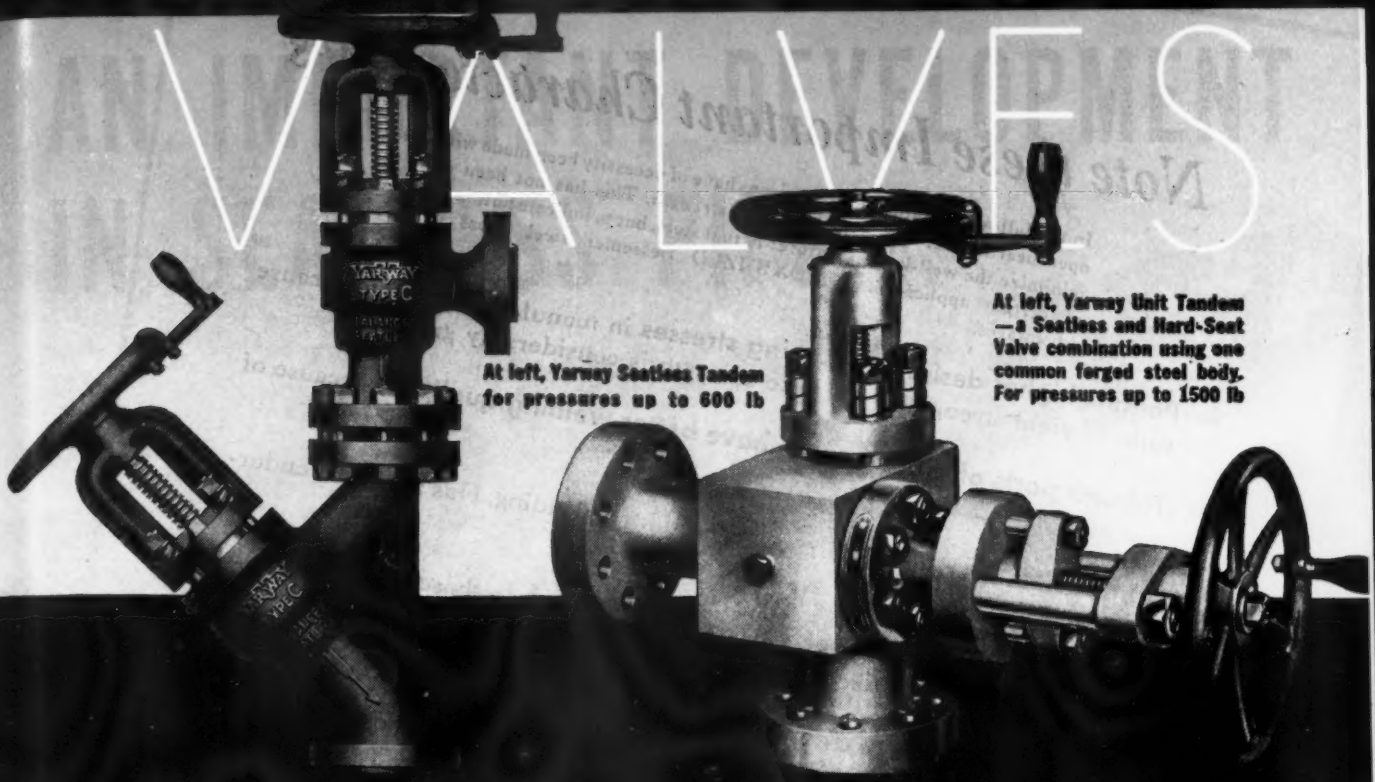
Because the Yarway line is complete you may be sure Yarway recommendations will be unbiased, based on honest judgment that the type valve selected will give long, trouble-free, money-saving service on the job.

Write for catalog; For pressures up to 400 lb, Section 424; For higher pressures, Section 431.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY

VALVES



At left, Yarway Seatless Tandem for pressures up to 600 lb

At left, Yarway Unit Tandem —a Seatless and Hard-Seat Valve combination using one common forged steel body. For pressures up to 1500 lb

PRESSURE

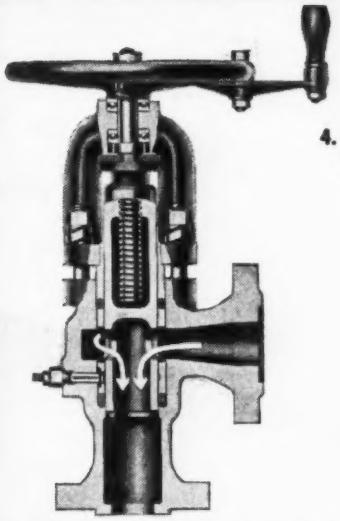
Yarway Type B Seatless Valves are of balanced, sliding plunger design. Made in Angle (Fig. 1) and Straightway (Fig. 2) Types. Operation of Yarway Seatless Valves: After valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packings P, above and below port, making an absolutely tight valve. Yoke springs T maintain continuous pressure through follower glands F, on packing rings P. Annular groove O connects with alemite fitting for lubricating plunger and packing; alemite lubrication also provided for stem.

•

Yarway Type C Seatless Valves (Fig. 3) are made in both angle and straightway types. In this design the longer plunger protects the packing from blow-down at all times. Other features are laminated packing with stainless steel inserts, nitralloy plungers, alemite lubrication, ball thrust bearings.

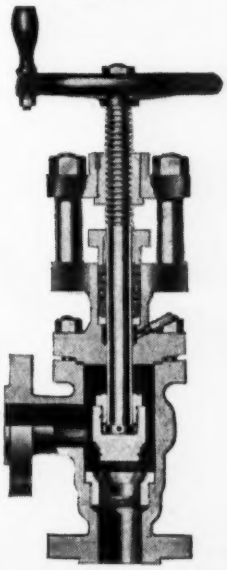
•

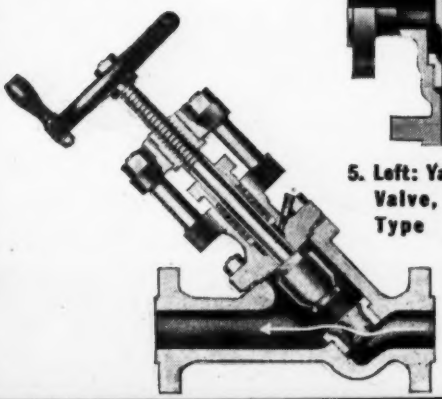
Yarway Hard-Seat Blow-Off Valves are of cone seat and disc type, having metal-to-metal contact. These valves are made in angle type (Fig. 4) and straightway easy flow type (Fig. 5). Features of the Yarway Hard-Seat Valve include: Marine and cast steel type yoke with threaded bushing, packing gland with bronze liner, large packing space, long-shank stem. Disc and seat ring are stainless steel; beveled faces have stellite inserts which provide smooth, hard-wearing surfaces at this important point.



3. Above: Yarway Type C Seatless Valve, Angle Type

4. Below: Yarway Hard-Seat Valve, Angle Type





5. Left: Yarway Hard-Seat Valve, Straightway Type

BLOW-OFF VALVES

Note these Important Characteristics

In the following features, comparisons have of necessity been made with basic open hearth steel of the *same tensile strength*. This has not been done to minimize the well-known features of that steel, but to indicate how in the case of certain applications, DEOXIDIZED Bessemer steel offers definite advantages.

★ **Permits higher design or working stresses** in manufactured parts because ratio of yield strength to ultimate strength is considerably greater.

★ **Tubular parts of high strength have better welding qualities** because of low carbon content.

★ **Parts last longer** under dynamic conditions of loading. Has a higher "endurance limit."

★ **Ductility and toughness of parts are fully equal** to those of steel of same hardness and tensile strength.

★ **Greater resistance to creep** when subjected to high temperatures up to 850°F. Permits a higher unit stress in designing.

★ **Ideally suited for tubular columns, beams, poles** and other structural purposes. Has higher resistance to failure by buckling. Permits higher design loads.

★ **Greater stiffness.** Highly desirable for drive pipe and tubular piling.

★ **Can be carburized in tubular parts** requiring hard, wear-resistant machined surfaces and greater core strength.

★ **When copper-bearing,** has superior atmospheric corrosion resistance.

★ **Fine grain structure.** Minimum of inclusions. Is cleaner.

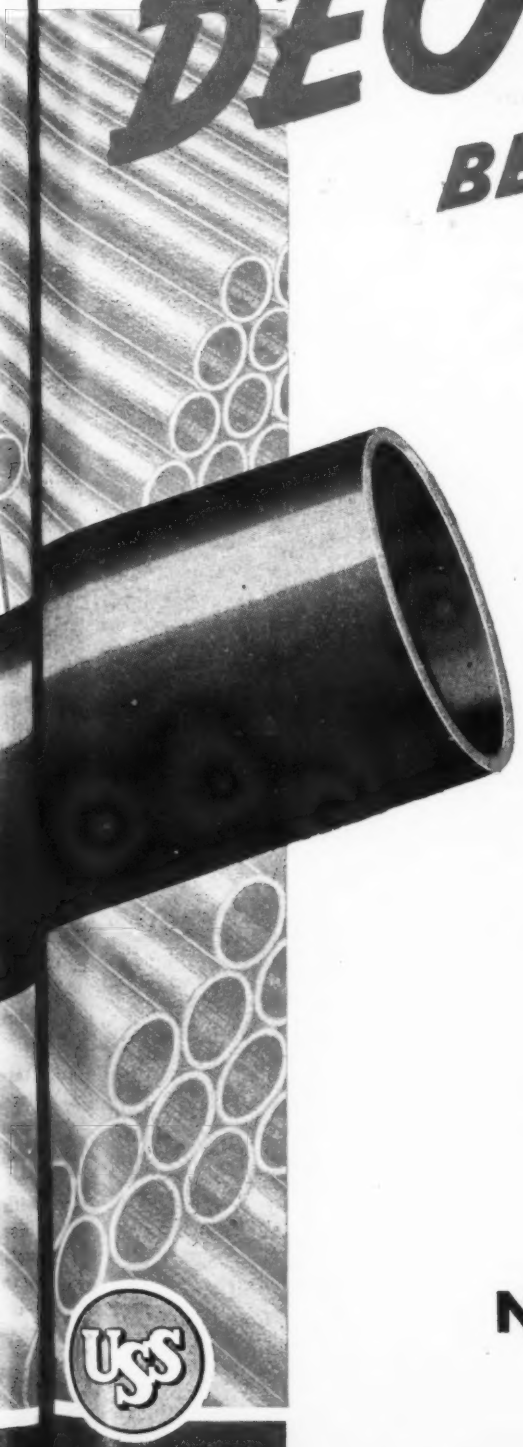
★ **Good machining properties.**

UNITED STATES STEEL

AN IMPORTANT DEVELOPMENT IN SEAMLESS PIPE...

DEOXIDIZED BESSEMER STEEL

. . . a product of National Tube research, proves its superiority in many applications



YOU may find it hard to believe. Others did. But once they saw the remarkable transformation the old, familiar Bessemer steel went through when DEOXIDIZED, they were convinced. For there it was—a steel with qualities it never had before—greatly expanded in its usefulness and versatility.

DEOXIDIZED Bessemer Seamless pipe and tubing offers striking proof of this. It would be difficult to find a severer quality test than the piercing process which produces *WALLS WITHOUT WELDS.* That's why you will want to become familiar with the particular characteristics of this steel. They suggest many applications to the manufacturer, fabricator, or builder.

DEOXIDIZED Bessemer steel is not meant to wholly supplant other steels for tubular products; there are some cases where other steels may serve equally well or better. It is merely another in the great steel family which will be preferred for most pipe and tubing applications simply because for such applications it has particular merit.

DEOXIDIZED may be a new word to you when used in this connection. But there is nothing new about it to the metallurgical engineers who developed the process and have watched the performance of hundreds of thousands of tons under exacting conditions of use, time, and form.

Watch this steel. You are going to hear much more about it as the time approaches when it can be put into greater production. We predict you will find many applications where DEOXIDIZED Bessemer steel Seamless pipe will prove actually superior to any you have used before. Descriptive literature sent upon request.

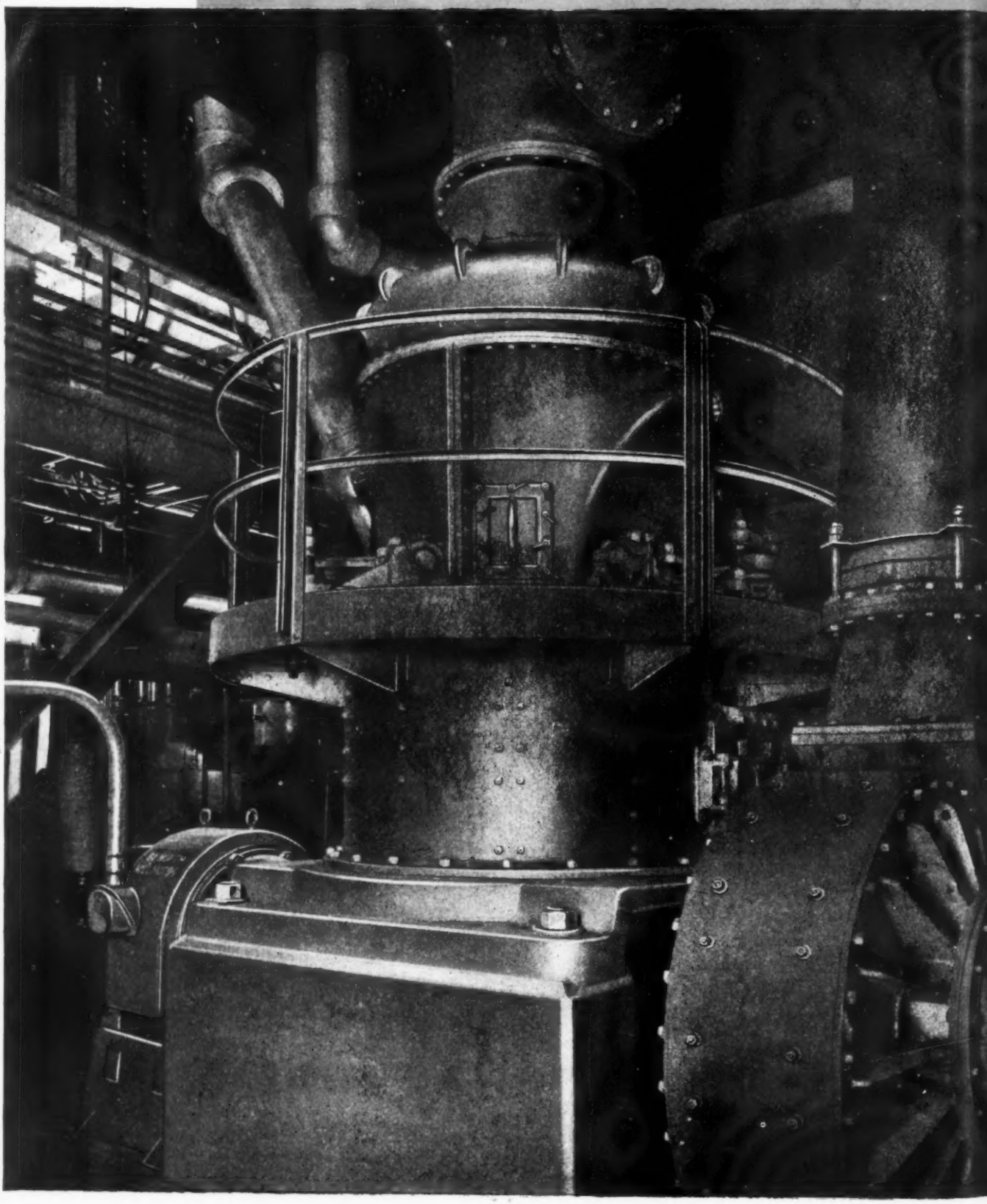
NATIONAL TUBE COMPANY

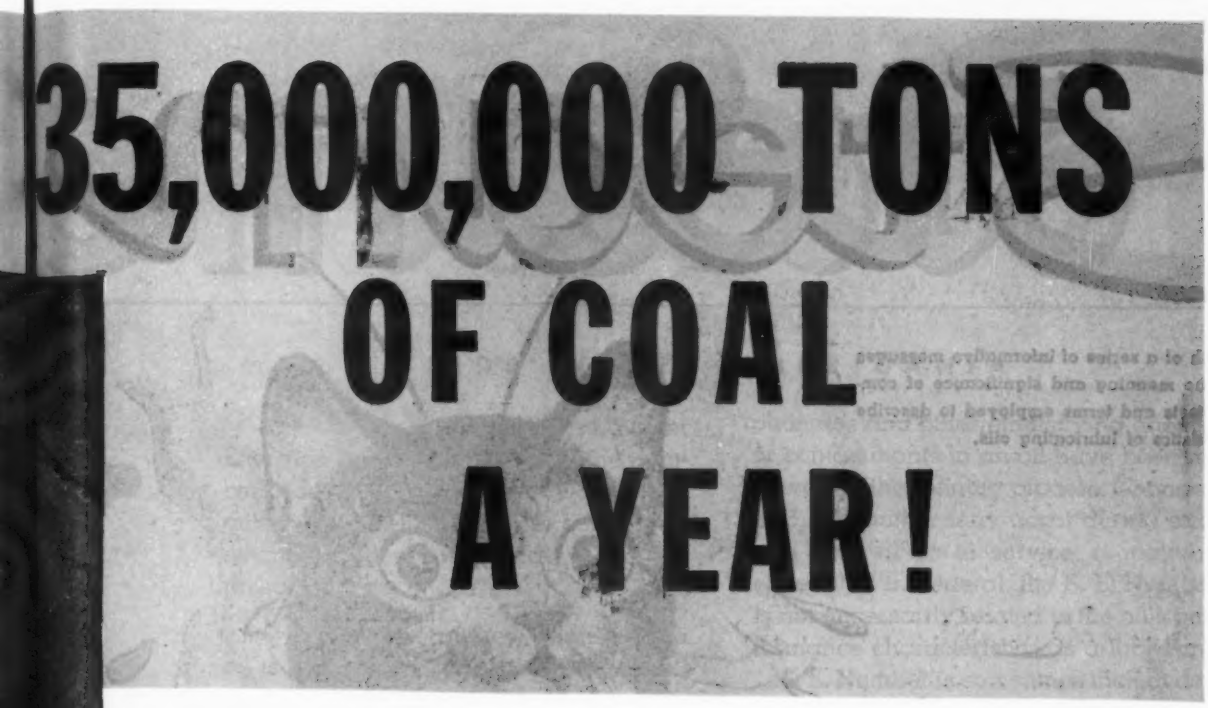
PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Export Company, New York

GRINDING





35,000,000 TONS OF COAL A YEAR!

IMAGINE 35,000,000 tons of coal — or picture 700,000 loaded coal cars stretching from New York to Cairo. Such is the aggregate of the amount of coal we can assume is being pulverized in a single year by all the C-E Raymond Bowl Mills purchased to date. Obviously the figure is an approximation, but a conservative one, since it is based on an average of 5,400 operating hours for each mill — about 60% of the total number of available hours in one year.

This grinding capacity serves to show the remarkable acceptance accorded the C-E Raymond Bowl Mill for pulverized coal fired installations. It is the more remarkable when you remember that the C-E Raymond Bowl Mill was placed on the market only 9 years ago. This is a strikingly brief period of time for a piece of major industrial equipment to win such widespread endorsement. But it's a likely result of the superiority demonstrated by the C-E Raymond Bowl Mill in such desirable qualities as dependability, noiselessness, low power consumption and low maintenance expense. A-784

COMBUSTION ENGINEERING

200 MADISON AVENUE NEW YORK 16, N.Y.

Canadian Associates: COMBUSTION ENGINEERING CORPORATION LIMITED • Montreal • Toronto • Winnipeg • Vancouver

Steam

✻ This is the 9th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

emulsion

TIDE WATER . LUBRICANIA

DEFINITION: The A.S.T.M. Steam Emulsion Number (S. E. No.) is the number of seconds required for an oil to separate when emulsified with condensed steam and separated under definitely prescribed conditions.

TEST: A predetermined volume of the oil is placed in a test tube of prescribed size, which in turn is placed in a bath of water. A steam delivery tube is inserted into the oil extending to the bottom of the container. Steam is passed into the oil at such a rate as to maintain the temperature of the oil at 190-195°F. until the volume of the emulsion of oil and condensed steam is 40 ± 3 ml. The test tube containing the oil is next transferred to a separating bath maintained at a temperature of 200°F. to 203°F. The contents of the oil container is examined every 30 seconds. The time in seconds required for the separation of the 20 ml. of oil is reported as the A.S.T.M. Steam Emulsion Number.

SIGNIFICANCE: (S. E. Number) when applied to an unused oil indicates whether certain compounds (soaps, sulphonates and other emulsifying agents) or contaminants in an oil have been removed in the refining process. Changes in S. E. Number may occur during storage as well as in service. It may be stated that in general, the S. E. Number is not necessarily related to the oil's performance characteristics as a lubricant.

S. E. Number is sometimes included in the specification for certain oils, but there is no uniformity of opinion as to its practical value. This test as applied to used oils may be considered as of little significance.

Tycol lubricants are made from the most suitable materials. They are scientifically refined to meet stringent laboratory specifications and the recommended service requirement. It is this combination that assures the outstanding performance of Tycol Industrial Oils and Greases.

TIDE WATER ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.

Principal Branch Offices: **Boston, Philadelphia, Pittsburgh, Charlotte, N. C.**

INDUSTRIAL LUBRICANTS

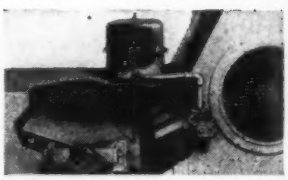
"Our IRON FIREMAN save 20% in coal, 30%

—estimates J. R. Burke, maintenance foreman, Pittsburg

PITTSBURGH PLANT MODERNIZES BOILER ROOM

IN the summer of 1940 the Pittsburgh Equitable Meter Co., the world's largest manufacturer of water and gas meters, completely modernized its boiler plant. Due to the growth of company business, the old boiler plant was inefficient and inadequate to meet steam requirements, even in the handling of rated capacity. They wanted an efficient boiler room installation that would hold labor to a minimum, dispose of combustible refuse, and have a low maintenance cost.

To meet these requirements the company decided to install two Pacific No. 75-S-1 boilers having 2,143 square feet of heating surface and an E. D. R. rating of 36,431 square feet. The boilers are stokered with two Iron Fireman Poweram stokers of 1,600 pounds hourly coal burning capacity.



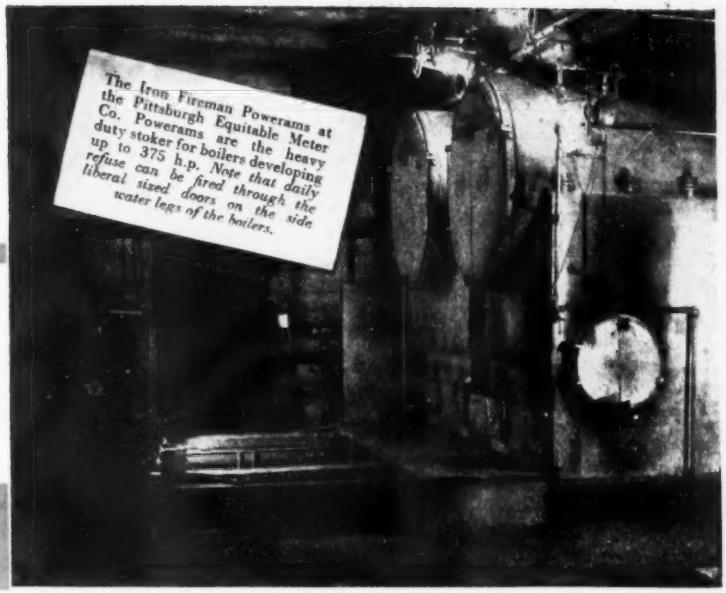
The Iron Fireman exclusive volumeter is highly responsive. Regardless of fuel bed conditions or the type of coal used, the Volumeter will always give the volume of air required.

The Iron Fireman stokers are equipped with motor driven forced draft fans. The forced draft air duct is equipped with a volumeter that meters the air for combustion in proper volume for the fuel burning rate. Variations in fuel bed resistance are automatically compensated for with no deficiency or excess of air, thus making possible high combustion efficiency.

STOKERS

in labor"

Equitable Meter Company



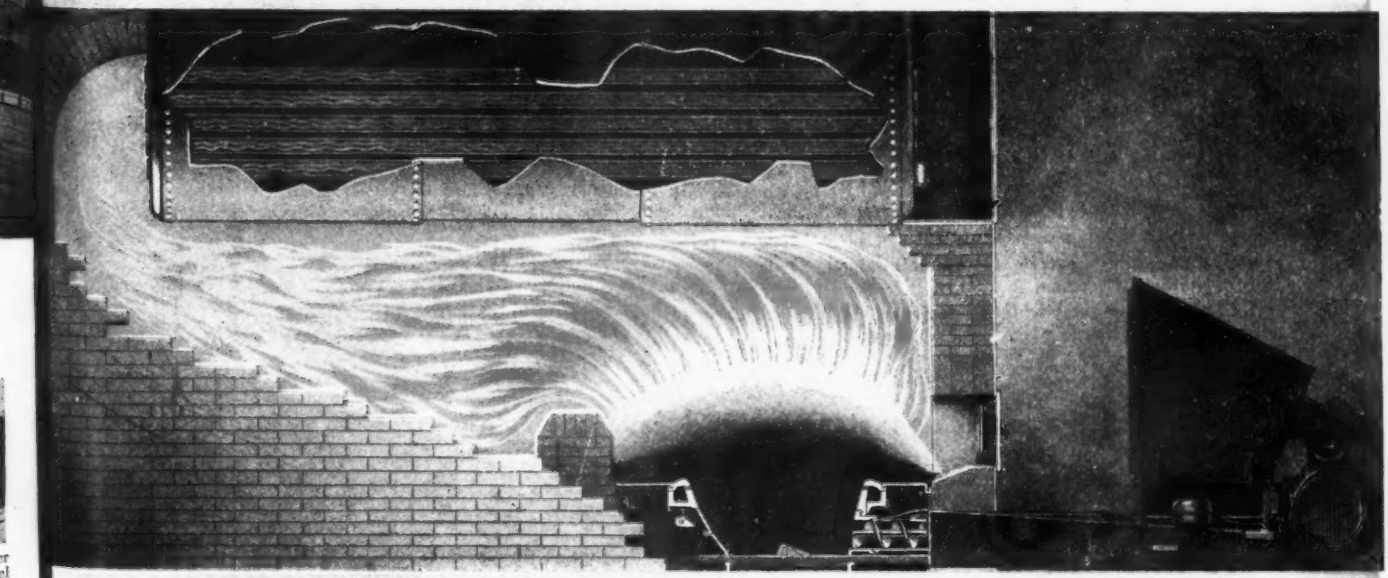
The Iron Fireman Powerams at the Pittsburgh Equitable Meter Co. Powerams are the heavy duty stoker for boilers developing up to 375 h.p. Note that daily refuse can be fired through the liberal sized doors on the side water legs of the boilers.

THE high combustion efficiency of the Iron Fireman stokers is responsible for a fuel saving of 20% over hand-firing at this plant. The Iron Fireman Poweram stokers installed here are of an extended design with a distance of 16 feet from the center line of the retort to the center line of the coal hopper. The extended design was selected so the coal hoppers could be filled directly from the coal bin, thus avoiding the wheeling of coal from the bin to hoppers located at the boiler front. This design helped to make the 30% reduction in labor.

The extended arrangement keeps the boiler room clean. There is no wheeling of coal, piling of it in front of boilers or shoveling.

Iron Fireman Stokers Available

Iron Fireman commercial and industrial stokers are in full wartime production. Our nationwide organization of qualified engineers and dealers will make a free survey to determine what Iron Fireman can do for you. Write the Iron Fireman Manufacturing Company, 3271 West 106th Street, Cleveland 11, Ohio.



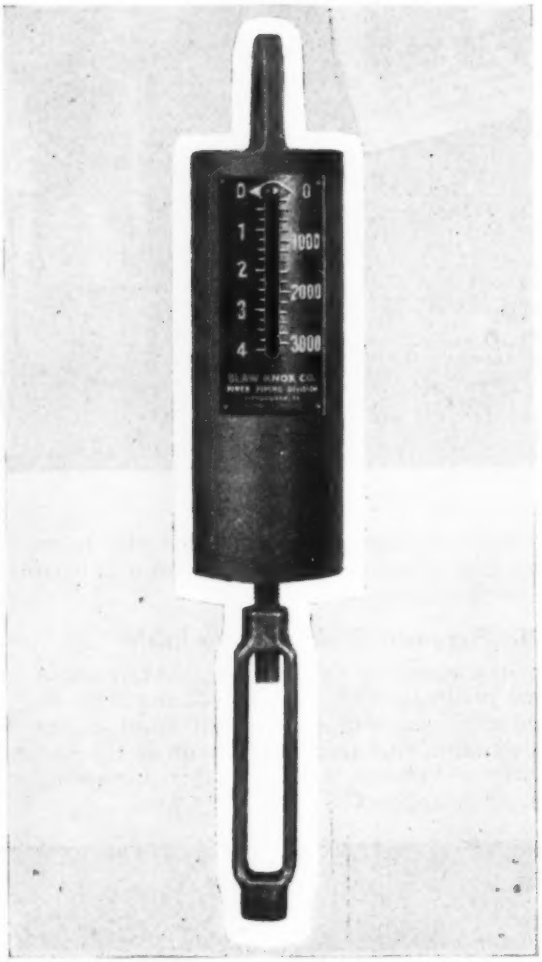
The Iron Fireman Poweram design combines non-packing screw-conveying with reciprocating retort distribution. The reciprocating blocks in the bottom of the retort eject fuel from the retort and properly distribute it over the burning area of the stoker. The Iron Fireman slowly preheats the coal, bringing it up to the ignition temperature as it nears the top of the fuel bed. An Iron Fireman fired boiler is never choked with coal, nor is the fire allowed to unduly die down. Automatic controls insure the fuel supply necessary for current steam demands.

IRON FIREMAN

THE IRON FIREMAN

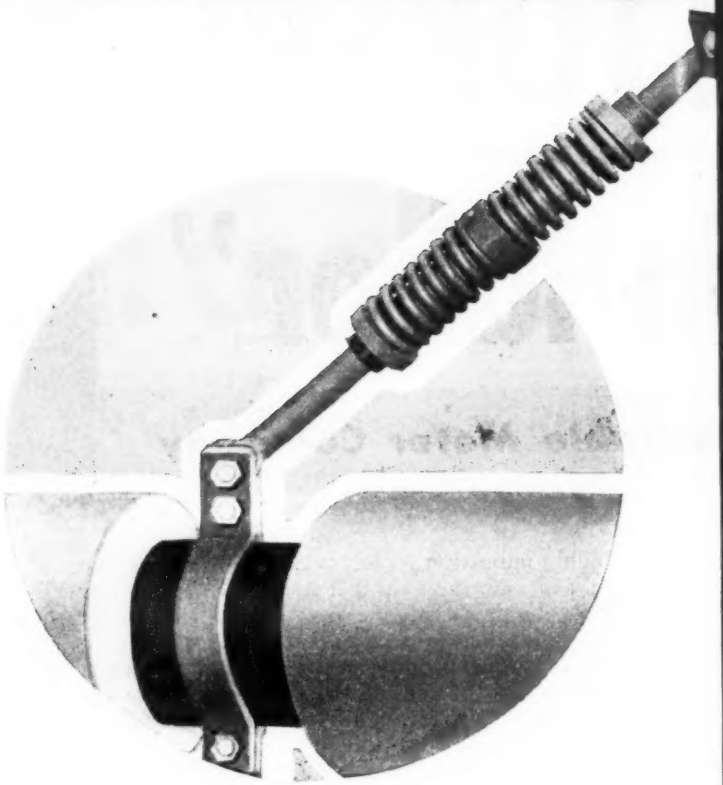
Automatic Coal Stokers

POWER PIPING



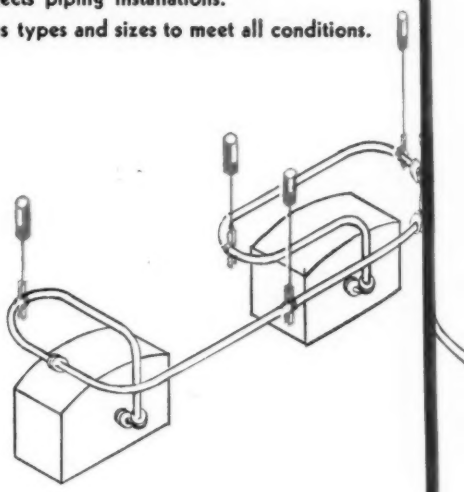
FUNCTIONAL HANGERS

SCALE—Actual load indicated in Lbs. at all times.
SPRINGS—Totally enclosed and guided.
ROD—Pivotal action swings freely with complete lateral and longitudinal movement.
SHORT HEADROOM—Turnbuckle adjustment 11⅛" minimum for any load.



VIBRATION ELIMINATORS

SWIVEL ACTION—In all directions.
ADJUSTMENT—For any degree of dampening effect and location.
SHOCK ABSORBER—Protects piping installations.
COMPLETE LINE—Various types and sizes to meet all conditions.



These products are standard and save thousands of man hours in design, fabrication and erection of piping systems.

* The correlated use of FLEX-ANAL CHARTS and HANGER BULLETIN 1863 saves time in engineering man power which can be devoted to other useful purposes. Copies of these books can be obtained through a request on your business letterhead.

ENGINEERING • PREFABRICATION • ERECTION OF POWER PIPING SYSTEMS

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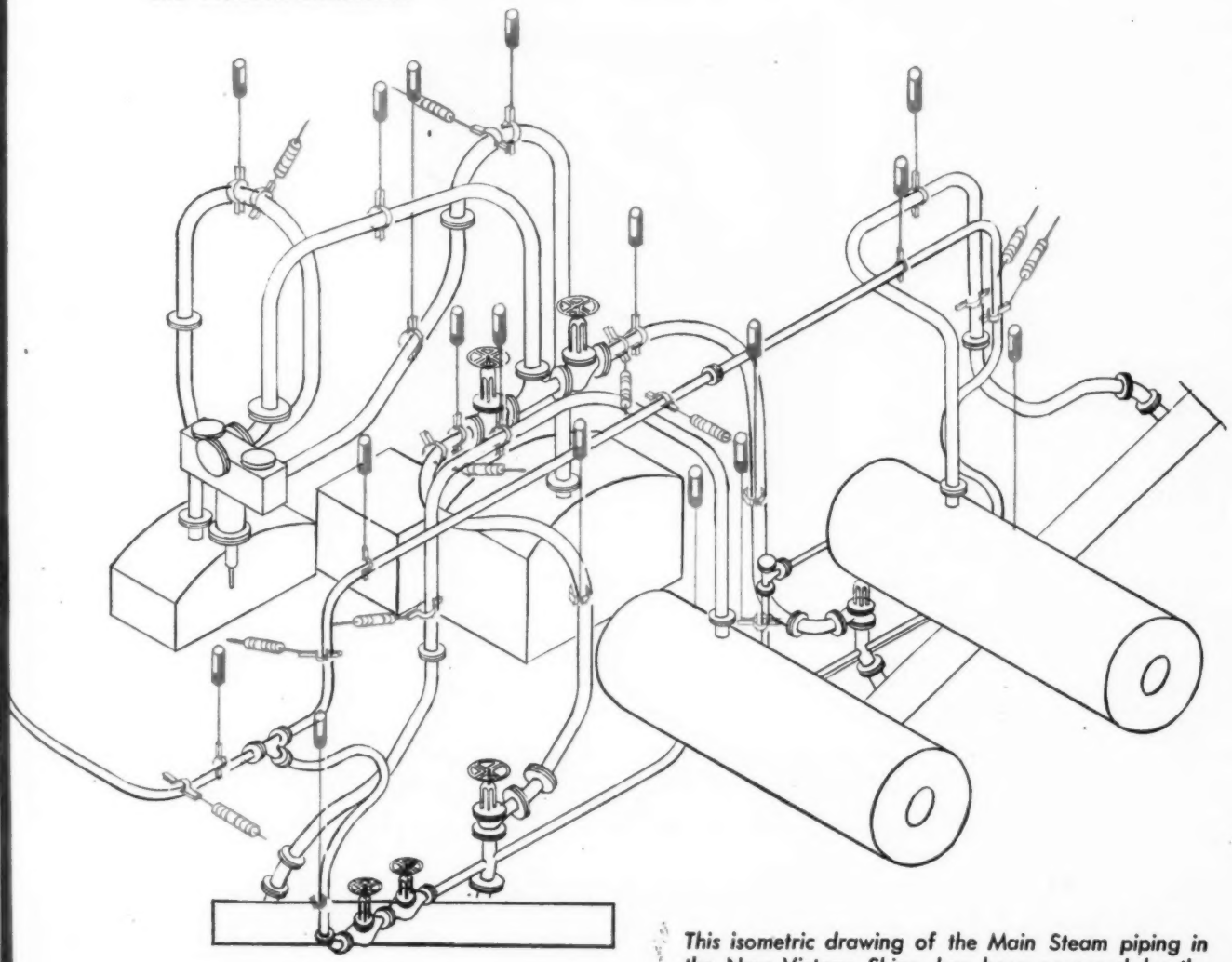
FUNCTIONAL HANGERS AND VIBRATION ELIMINATORS

... for Victory Ships

POWER PIPING DIVISION—Pioneers in the development of the Simple Type Functional Spring Hanger and Vibration Eliminator. Modern, original designs which permit engineers to correlate the* "Design of Piping for Flexibility" with the proper method of installing supports to carry the dead weight of the pipe, eliminate vibration, absorb shock and control the movements. ¶Victory Ships are equipped with standard Blaw-Knox Power Piping Functional Hangers and Vibration Eliminators.



This isometric drawing of the Main Steam piping in the New Victory Ships has been prepared by the Blaw-Knox Co. Power Piping Division to facilitate the installation of our standard Functional Hangers and Vibration Eliminators.

BLAW-KNOX COMPANY

POWER PIPING DIVISION

1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

[PUMP TIPS FROM ALLIS-CHALMERS — ONE IN A SERIES]

How to make BEARINGS Last Longer . . .

ONE OF THE MAIN CAUSES of bearing trouble is misalignment. For when pump and its driving motor are not correctly aligned, every revolution of the shaft throws tremendous extra load on all moving parts within the pump's closely fitted body — resulting in greatly accelerated wear, oftentimes in complete bearing failure.

In an effort to eliminate the misalignment factor, A-C developed, for many applications, the "Electrifugal" pump — in which both motor and pump impeller are mounted on one shaft and in one frame. This *unit-design* prevents shaft from getting out of line . . . minimizes possibility of excessive bearing wear.

However, many pumps in use today are coupled to *separate* driving motors. In guarding against misalignment in this type pump, see that coupling flanges are perfectly aligned — and that they're kept that way!

Allis-Chalmers "Electrifugal" Pumps are equipped with two large ball bearings which support both the rotor and runner on one shaft.

Regardless of whether your pumps are equipped with ball, roller or sleeve bearings, here are a few maintenance tips that can prove useful to you in getting longer life out of bearings:

▶ Although too much oil won't harm sleeve bearings, too much grease in anti-friction type bearings will *promote* friction and heat. Main job of grease in anti-friction bearings is to protect steel elements against corrosion, not friction.

▶ No one rule on lubrication frequency fits all pump installations. So play safe: if anything, change lubricant *before* it's too worn or too dirty.

▶ Once a month, check bearing temperatures with a thermometer . . . *not by hand.*

▶ In the case of sleeve bearings, measure bearings for wear every three months, replacing them if wear is excessive. Generally allow two-thousandths of an inch clearance — plus one-thousandth of an inch for each inch of shaft journal diameter.

▶ Every three months, drain lubricant, washing out oil wells and bearings with kerosene. In the case of sleeve bearings, check to see that oil rings are free to turn with the shaft.

▶ If you haven't done so already, send for Allis-Chalmers' *free* "Handbook for Wartime Care of Centrifugal Pumps". Applies to *all* makes of pumps; contains *no* advertising. Contents include: valuable tables of friction losses; handy guide to locating trouble; wartime maintenance schedule. Address your request to ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

A 1709

♪ *Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.*

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.

BIGGEST SUCCESS IN V-BELT HISTORY!

Million Goodyear Steel Cable Belts take over toughest "belt-eater" drives

SINCE its introduction a little over a year ago, the Goodyear Steel Cable V-Belt has convincingly demonstrated its great superiority over any other type of V-belt.

On the hardest belt-killing multi-V drives — on drives where V-belts were never thought practical before — it is handling the load with ease.

On all types of military equipment — on fans, pumps and turrets in tanks, troop carriers, armored cars and landing barges — it is giving round-the-clock service where conventional belts quickly failed.

More than a million of these belts now in use have given such stand-out performance, many plants now want them for all multi-V drives.

It's stronger—more flexible

The reasons are simple. The Goodyear Steel Cable belt has far greater power capacity than conventional cord belts — strength to spare for peak overloads, or the higher tension of low speeds.

This greater strength makes it possible to pull a given load with fewer belts, making a more compact drive, often eliminating outboard bearings. Or heavier loads can be handled with no increase in number of belts.

Yet it is more flexible than ordinary belts, grips the sheaves uniformly. It has practically zero stretch, therefore retains constant length in service — does not shrink in storage. Once matched, a set is always matched.

For full information about this revolutionary and exclusive Goodyear development, see the G.T.M. — Goodyear Technical Man. Or phone your nearest Goodyear Industrial Rubber Goods Distributor.

GOODYEAR INDUSTRIAL RUBBER PRODUCTS
GTM - Specified STEEL CABLE V-BELT for Multi-V drives
1. Heavy, super-tough black cover with uniform friction, longer life
2. Load-carrying, endless, steel cables in neutral plane
3. Tension and compression sections of high-quality rubber
GOODYEAR
THE GREATEST NAME IN RUBBER

★
LET'S ALL BACK THE ATTACK—
WITH WAR BONDS
★

Jungle

TEXACO

TEXACO

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT — CBS

Juggernaut

OUR jungle fighters move up, and in no time at all big guns are rolled into place, roads and airstrips built and the war is carried to the enemy from another advanced base.

It takes *power* to drive through the jungle . . . power that's largely supplied by Diesels. Diesels are in the fight at home, too . . . and on all fronts they are rendering excellent service lubricated with Texaco.

Texaco Algol or Ursa Oils, for Diesels, increase life of rings, pistons, liners and bearings, keep rings free in their grooves, valves active, ports clear, assuring piston seal that means full power and maximum fuel economy. In fact—

More stationary Diesel hp. in the U. S. is lubricated with Texaco than with any other brand.

Texaco Lubrication Engineering Service is available to recommend the most suitable grade of *Ursa Oil* for your Diesels . . . through more than 2300 Texaco distributing points in the 48 States.

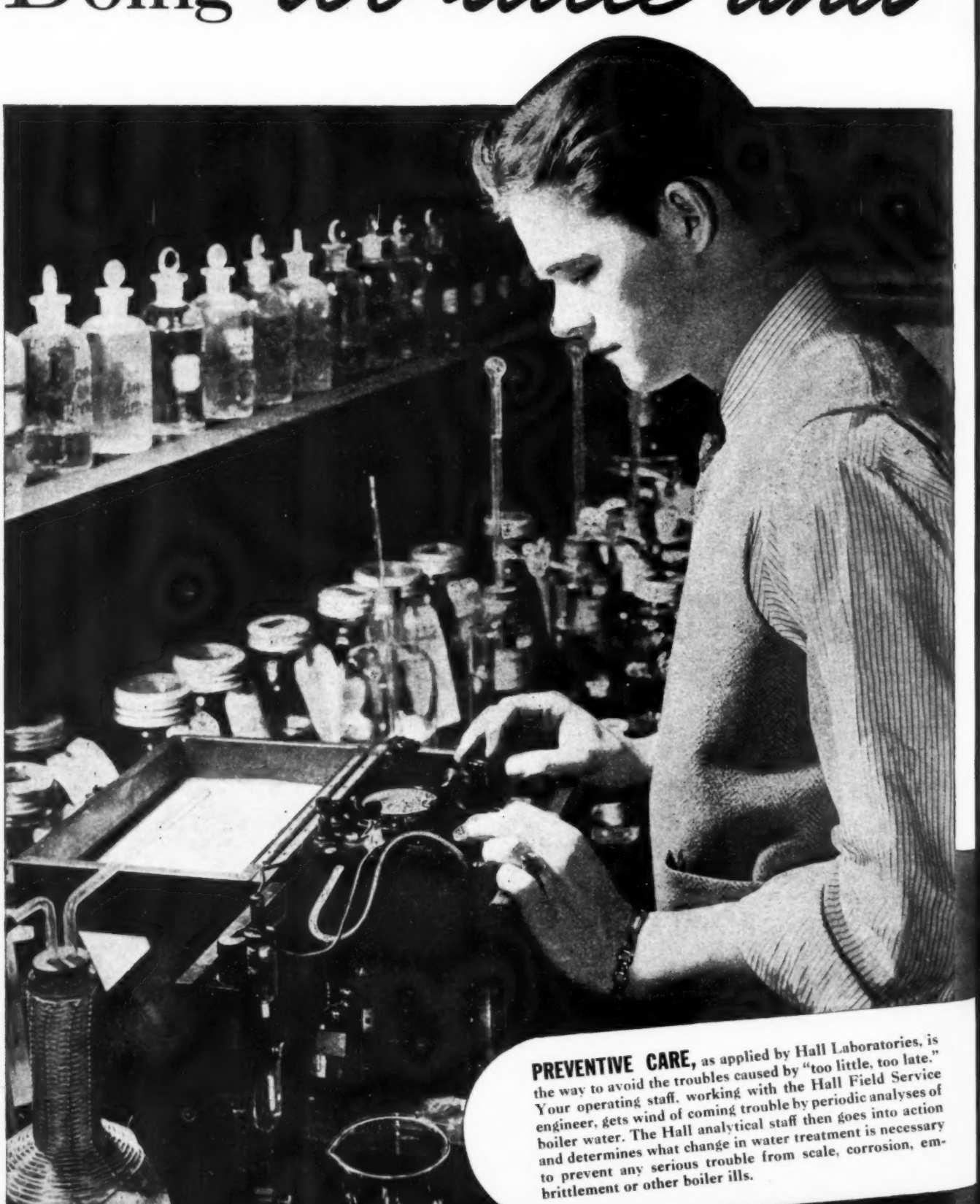
The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Lubricants and Fuels

FOR ALL DIESEL ENGINES

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

Doing "*too little and*



PREVENTIVE CARE, as applied by Hall Laboratories, is the way to avoid the troubles caused by "too little, too late." Your operating staff, working with the Hall Field Service engineer, gets wind of coming trouble by periodic analyses of boiler water. The Hall analytical staff then goes into action and determines what change in water treatment is necessary to prevent any serious trouble from scale, corrosion, embrittlement or other boiler ills.

too late" invites failure in the boiler room

CHANCES are you have never been faced with a boiler tube failure that could not be traced to doing too little and too late. Every time it happened you probably made up your mind that you would not let it occur again—but it did. That is, unless you had become a convert to *preventive care.*

Preventive care, as applied by Hall Laboratories, has probably been responsible for keeping more boilers on the line during this war emergency than any other thing. If its practice had been known during World War I, we would never have had such a tragic history of power failure.

Today, power plant engineers know that the right way to lick the problems of scale, corrosion, embrittlement and carryover is to hit them before they start. And they recognize the need for help from the trained specialist.

From its beginning, Hall research has been concentrated on finding the causes of boiler ills and what to do to prevent their occurrence. That is why Hall Laboratories has enjoyed such a distinguished record of success. Trained in the details of accurate diagnosis, the Hall field engineer sets up a program of preventive care which will meet your own plant's particular needs. If your plant is in trouble now, he will work with you to correct it. From that time on moderate supervision is all your plant will need.

Supporting these field men is the finest equipped laboratory in the world devoted exclusively to the solution of boiler water problems. Many of the important advances in the science of industrial water conditioning owe their origin to the pioneers who man its staff.

It is never too late to start practicing preventive care. May we tell you more about it?

HALL LABORATORIES · HAGAN BUILDING · PITTSBURGH 30, PA.

A Subsidiary of Hagan Corporation

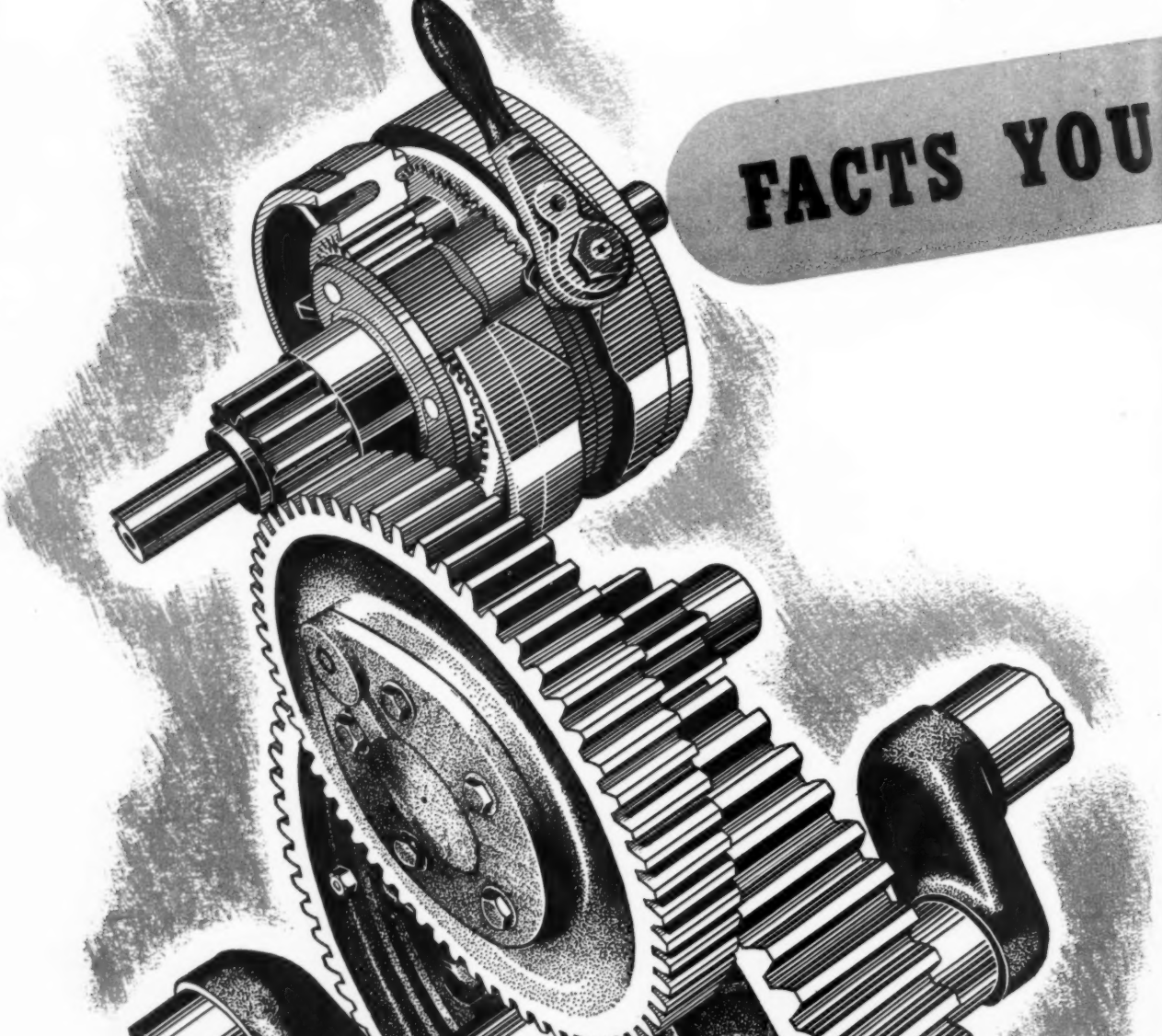
HALL SYSTEM
of Boiler Water Conditioning

HAGAN
HALL
BUROMIN
CALGON

Hall Service in a Nutshell

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. Minimizes boiler outages caused by water.
2. Helps maintain highest efficiency.
3. Establishes non-embrittling water.
4. Minimizes carryover.
5. Prevents corrosion in boilers and associated equipment.
6. Prevents deposition in water lines and cooling systems.


FACTS YOU

SHOULD KNOW ABOUT THIS—

SPUR GEAR PLANETARY DRIVE

THE TAYLOR STOKER 2-speed Power Box, an all spur-gear planetary transmission, transmits the power to operate the main coal feeding rams, and the fuel distributing members.

It provides two speeds and a neutral position.

Speed changes are made with gears in mesh at all times. No disengagement of gears is required. No clutches, thrust washers, thrust bearings or stuffing boxes are employed in this unique all-spur gear planetary transmission.

Simplified construction results in lower maintenance costs, and more efficient transmission of power.

The spur gear planetary construction now employs a triple gear cage pinion which results in a more balanced drive with minimum wear on the component gears of the entire transmission.

There are 6 other distinct advantages of the Taylor Stoker Power boxes:

1. The entire drive is protected by an easily accessible shearing pin.
2. Outer rim of main gear is renewable, easy and economical to replace.
3. Oil return device keeps oil level in upper casing constant.
4. Bushed bearings.
5. Design permits motor to be mounted right on power box to form a compact driving unit.
6. A steam turbine may be furnished as an integral part of the Taylor Power Box—giving a 10 to 1 speed range.

The Taylor Power Box is only one of numerous features which make the Taylor Stoker advisable for efficient low cost steam generation.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. RELIABILITY—the ability to operate with minimum outage and minimum standby equipment.

2. CAPACITY—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. MAINTENANCE—the ability to operate continuously with minimum repair costs.

4. FLEXIBILITY—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. EFFICIENCY—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

6. OPERATION—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. ADAPTABILITY—the ability to meet special and limiting conditions, present and future—structural limitations utilization of present equipment, growth and change of power service demands.

8. FUEL FLEXIBILITY—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. REFUSE DISPOSAL—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

10. STACK DISCHARGE—the practical elimination of "smoke nuisance" without special equipment.

11. SPACE REQUIREMENTS—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

12. OBSOLESCENCE—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

A-E-CO TAYLOR STOKER

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA

Then he said to himself—

"IMITATE IN GOOD THINGS"

THERE'S a sermon in the words of China's leader, Generalissimo Chiang Kai-Shek, as blue laws were clamped on his people's tendency to imitate our jitterbuggy way of life. Said he:

"CHINA IS FAR BEHIND THE WEST IN INDUSTRIALIZATION. WE WANT TO IMITATE THE WEST IN GOOD THINGS . . . WHY IN SUCH THINGS AS DANCING?"

Well he knows that example is contagious behavior. Well he knows that it is by imitation, far more than precept, that men can learn effectively and build on that knowledge.

Well he knows that his industrial men see, in the material coming from America, that *recourse* to ARC WELDING provides three basic GOOD THINGS for China's victory, for China's industrial effectiveness, for China's social advancement . . .

(a) faster production of more products

(b) more effective products

(c) for less money.

"Imitate in good things," he says

Here, Generalissimo, is a GOOD THING to imitate in the fabrication and installation of *better piping at lower cost:*

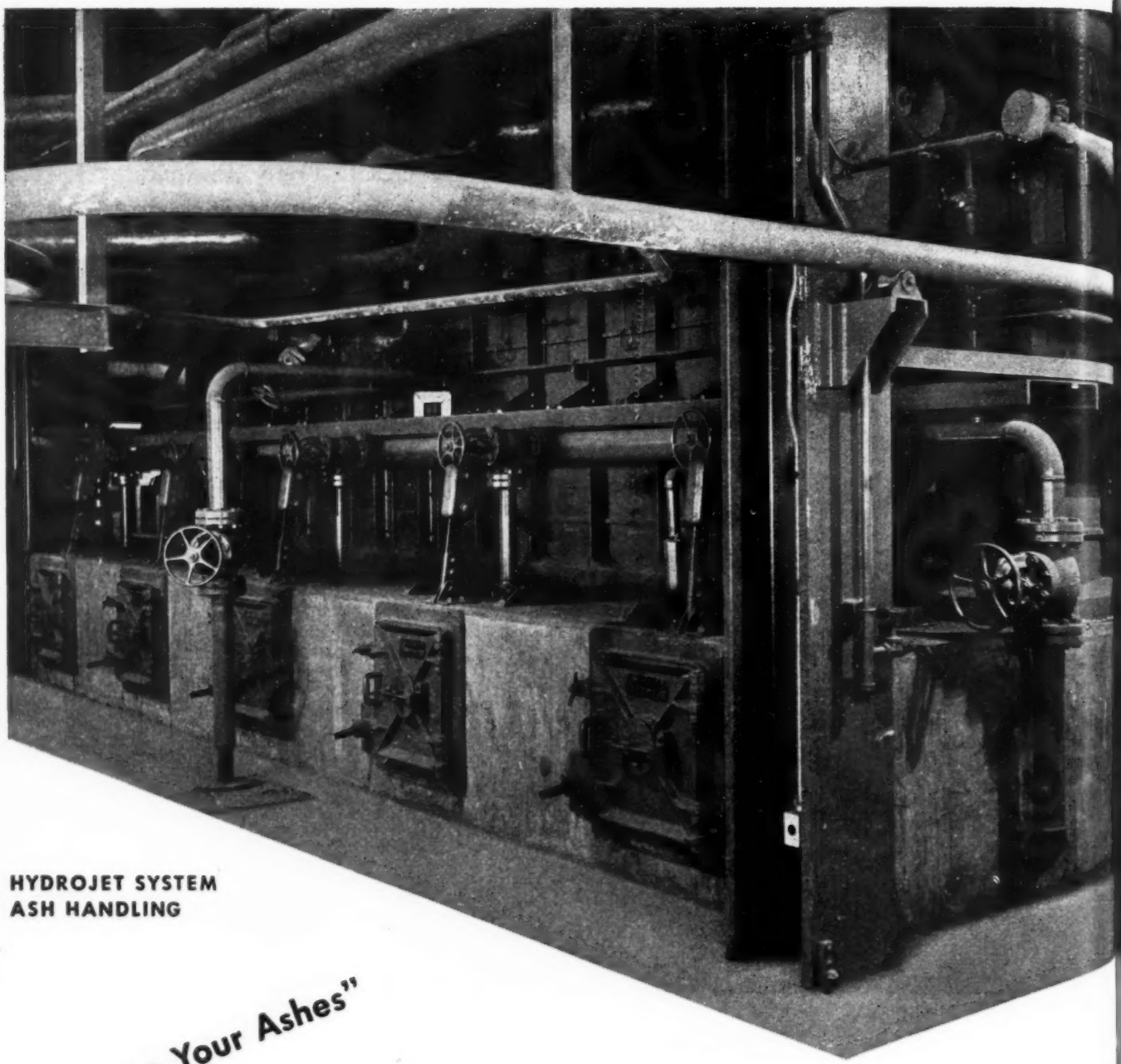
A GOOD THING IN PIPING

Recourse to Arc Welding saved the contractor on this apartment house job three to four times the price of his welding machine over other methods of welding or fabrication. Total 6,000 ft. of pipe from 2" to 12" diam. Steam line pressure 185 lbs. Valuable information on pipe welding on Pages 1104-1126 of *Procedure Handbook of Arc Welding.*

THE LINCOLN ELECTRIC COMPANY • Cleveland 1, Ohio

America's greatest natural **recourse**

ARC WELDING



HYDROJET SYSTEM
ASH HANDLING

"Pump Your Ashes"

MANPOWER SHORTAGES

Users of the Hydrojet System of Ash Handling and the Hydrovac System of Dust Handling have one less worry during these days of the Draft with its resulting scarcity of skilled labor. . . . Almost anyone can operate these systems and, in addition, only one or two men per shift are required to remove all incombustibles, even in the largest central stations. Hydroseal Ash Pumping to fill or Dewatering HydroBin makes refuse disposal as easy as its removal.

HYDROJET HYDROVA

ALLEN-SHERMAN-HOFF CO. 227 S. 15th Stre
Philadelphia 2, P

NAVY ACE

Written Specially for the Allen-Sherman-Hoff Co.

BY *Lowell Thomas*

Famous Radio News Commentator and Author

When the United States first entered the war, many of our would-be flyers were sorely disappointed. I mean those in their late twenties. Those who were adventure-minded, in particular, all craved to be fighter pilots. That is hardly surprising, since a fighter pilot has probably the most exciting and exacting job in the world. They learned to their amazement that at twenty-eight or at twenty-nine, in fact any age over twenty-five, they were deemed too old for the extraordinary physical stresses and nervous strains. Naturally, a healthy fellow considers himself at the height of his physical powers at twenty-eight or twenty-nine. So the ruling against them provoked much grief.

Lieutenant-Commander James Flatley, a Navy squadron leader who himself shot down four Japs in one day, said: "The best carrier fighter pilot of the war is Lieutenant Stanley Vejtasa." And, Vejtasa, a pilot with three Navy Crosses, is in his thirtieth year.

This doughty fellow comes from Circle, Montana. His parents are of Norwegian origin. So, his pals call him "Swede." They would!

He won his first Navy Cross in the battle of the Coral Sea. His second Navy Cross at Salamaua and Lae, in the air battles over New Guinea. On May 4th, 1943, he bombed Tulagi; on May 6th, he bombed a Jap carrier; and then on May 7th, he was attacked by nine Zeros at once while acting as anti-torpedo plane defense, flying a Navy dive bomber. Now those dive bombers are not so maneuverable. They are designed especially for the one purpose—dive bombing. On the other hand, the Zeros are amazingly maneuverable, because of their light construction.

Although the nine Japs had the jump on the lone Vejtasa he accepted the challenge—and by such skillful flying as is rarely seen, in a fight that lasted twenty-four minutes, he shot down three of them. It was then that Lieutenant-Commander Flatley made his remark about Vejtasa being the greatest carrier fighter pilot.

He took part in innumerable other raids and actions, and had done so much combat flying that he was ordered home for a well earned rest. And now listen to this: But for a suggestion from that same Commander Flatley, Vejtasa would not have lived to earn the third Navy Cross that he wears.

Flatley persuaded Vejtasa to postpone his furlough and stay aboard the carrier YORKTOWN for one more crack at the Japs. Vejtasa's gear was already packed and transferred to a refueling vessel, the ship on which he was to sail for home. But he couldn't resist the chance of one more combat in the sky. And, the Captain of the YORKTOWN okayed the idea, too.

The refueling ship on which Vejtasa was to have taken passage back to the United States had hardly left the sight of the YORKTOWN before she was sunk. So, if he had been aboard her, he would have perished with the others who went down with her.

Well, two days later, this thirty-year-old flier from Montana went up as leader of a combat patrol-flight of four planes. A large formation of Jap planes moved in to attack the YORKTOWN, in what turned out to be the beginning of the epic Battle of Santa Cruz. Vejtasa, leading his flight, took off, and at the first crack shot down two enemy dive bombers and damaged a third.

While the two Japs were falling into the sea, a squadron of twelve enemy torpedo planes came swooping down out of the clouds, heading for the big carrier YORKTOWN. Vejtasa maneuvered his flight so that the four American planes were right in their path. The Japs turned. As they did so Vejtasa bagged two of them. The rest flew into a cloud, in a tight *V* formation.

Fantastic though it seems "Swede" Vejtasa shot down three more of them, while they were in that white mist. Below them anti-aircraft gunners thought it was their ack-ack that had potted the three Japs. But later it turned out that it was Vejtasa who had shot them down.

And so it was that in one action, Lieutenant Vejtasa got seven Jap planes; a feat that hasn't been surpassed so far as I know.

Men of Norwegian blood are famous for being close-mouthed, but "Swede" Vejtasa makes all others look positively garrulous. Flatley related that immediately after this engagement, he spent eighteen days on a transport with Vejtasa. Throughout those eighteen day, "Swede" never mentioned the fight. The first that his superior officer heard of it was much later, when he sat in on an interview between officers of the Navy Department and some of the pilots. The Navy Department men asked Vejtasa about the fight. He told it reluctantly, they had to drag it out of him. When he had finished, one of the interviewers asked: "And what did you do then, Vejtasa?" And he answered: "Sir, I went back to my patrol station near the bow of the ship."

WRITE FOR LOWELL THOMAS BOOKLET

Following the publication of a few of these Lowell Thomas stories, we plan to publish the entire group in booklet form. In order to help us decide on how many to print, we'd appreciate your writing us now, so that we can reserve a copy for you. No obligation, of course.

YDROSEAL HYDRO BIN

FFICES AND REPRESENTATIVES IN MOST PRINCIPAL CITIES

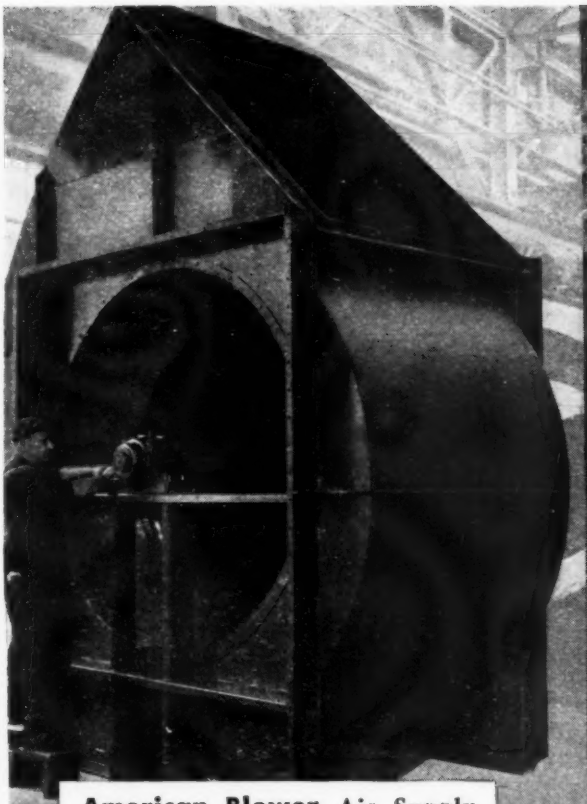
Progress and Power in the

The electrical manufacturing industry, which furnishes the equipment, and the Public Utilities which furnish the power, are in a large measure responsible for much of the progress in the America of today. It has been a privilege of American Blower to work with both of these great industries, furnishing mechanical draft equipment, fans, dust collectors and fluid drives.

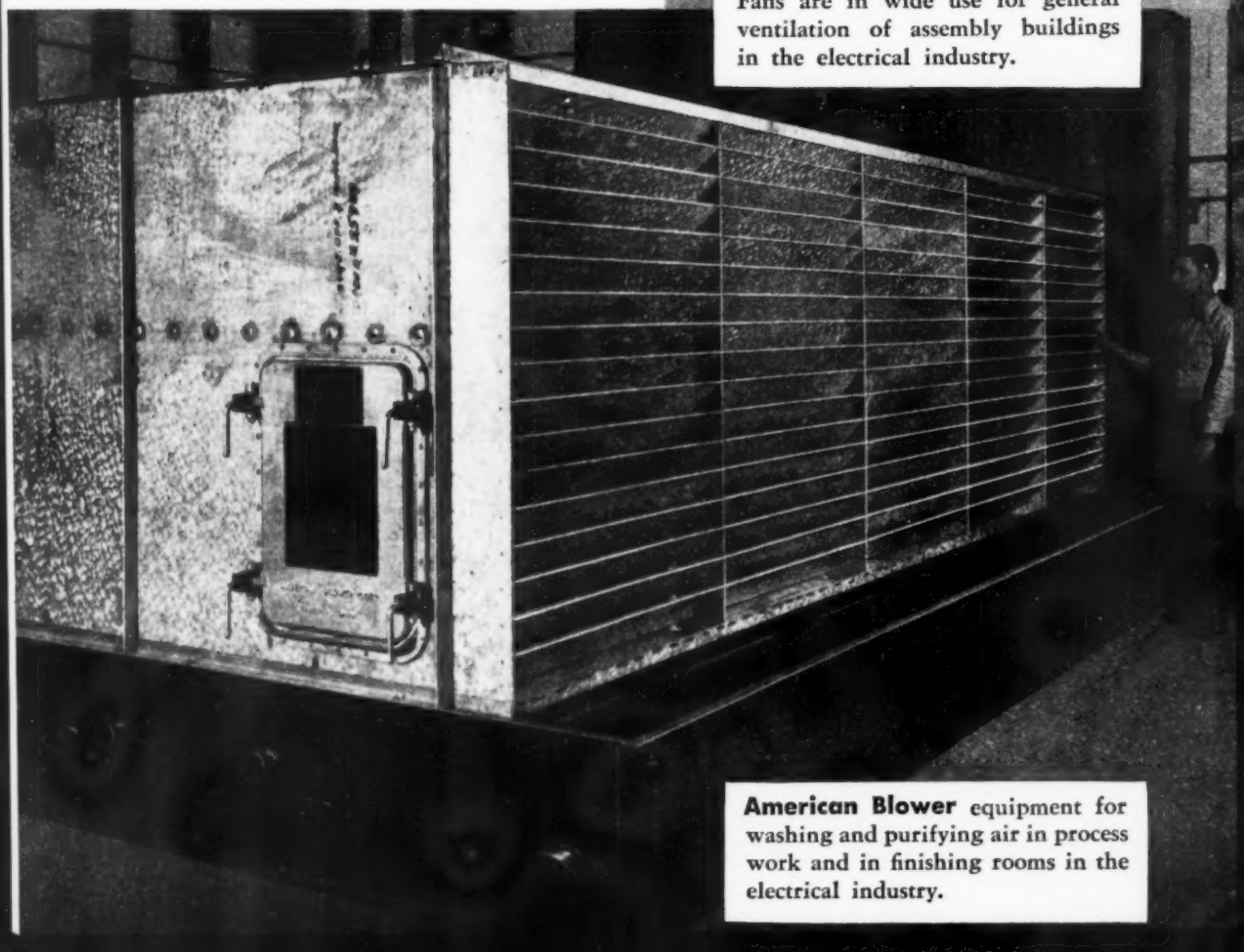
AMERICAN BLOWER

ARMY (E) NAVY
For Production "Well Done"

AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary Corporation

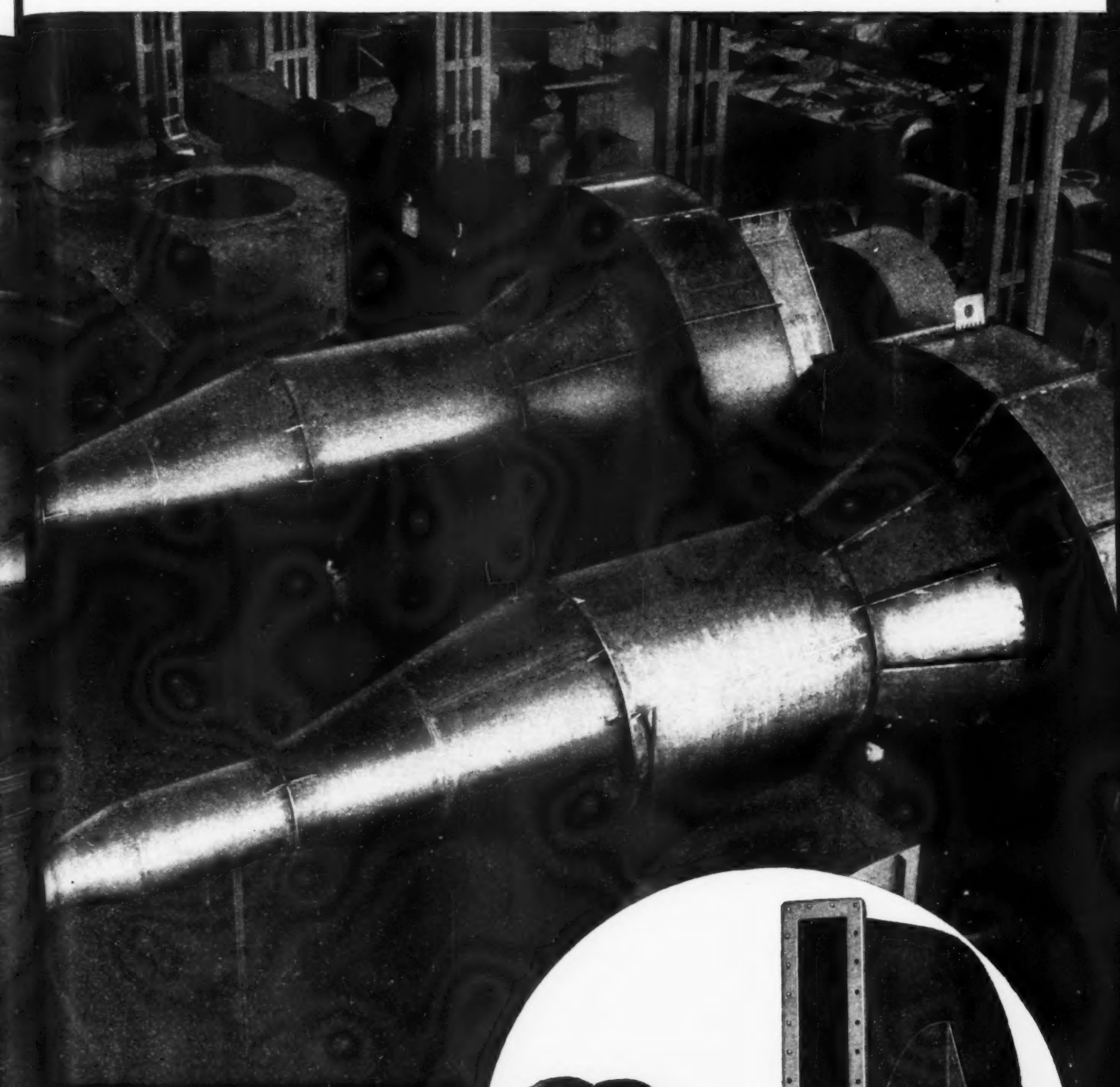


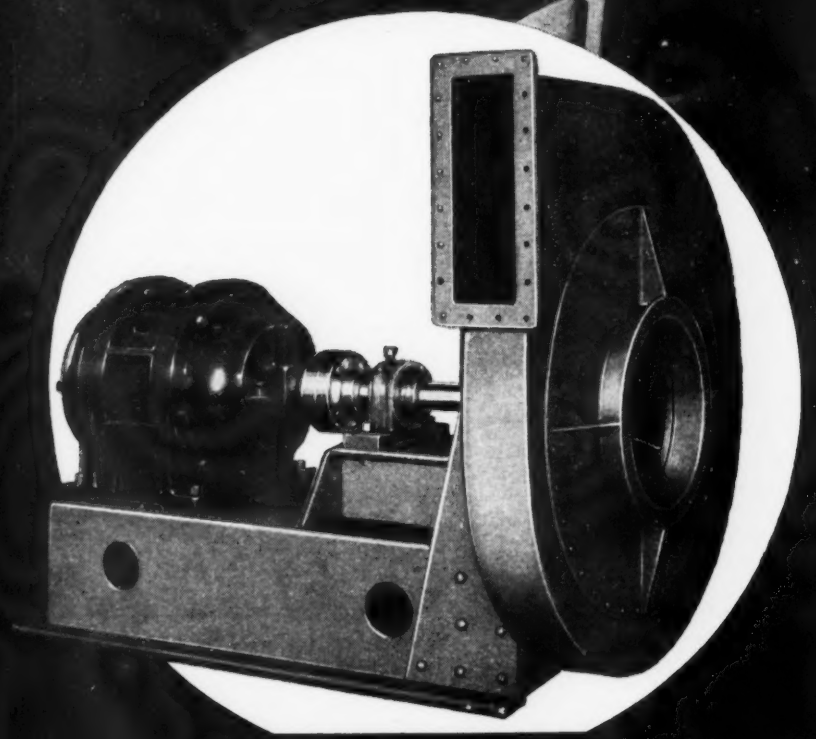
American Blower Air Supply Fans are in wide use for general ventilation of assembly buildings in the electrical industry.



American Blower equipment for washing and purifying air in process work and in finishing rooms in the electrical industry.

ELECTRICAL INDUSTRY





bove) — Ready for shipment, American ower Type "D" Centrifugal Collectors for llecting dust in iron and steel foundries d grinding operations in the electrical dustry.

• • •

Right) — American Blower Pressure owers find many industrial applications forges, burners and heat-treating ovens.

LEAKY VALVES DON'

Fig. 1430
Iron Body Gate

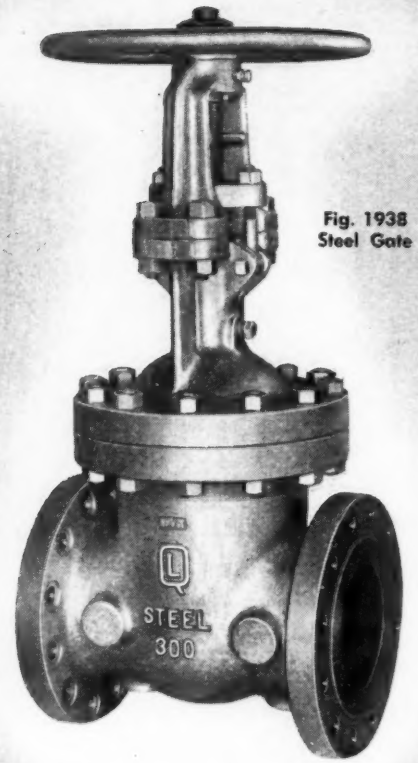


Fig. 1938
Steel Gate

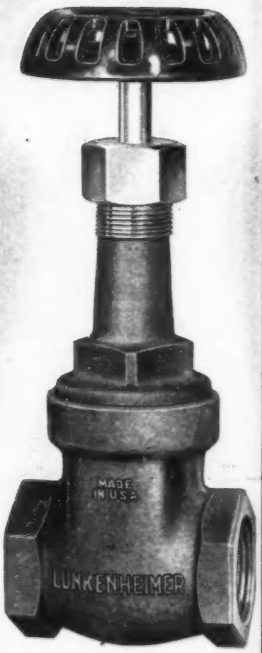


Fig. 2125
Bronze Gate

Fig. 1640
"King-clip" Gate

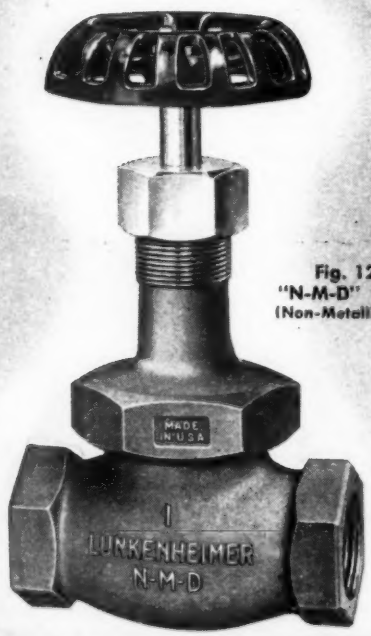


Fig. 123
"N-M-D" Globe
(Non-Metallic Disc)

LUNKENHEIMER

HELP PRODUCTION . . .

So Keep 'Em Tight

The time necessary to maintain a careful check on valves . . . to see that they are kept tight and in good working order . . . is time well spent. Valves are tremendously important links in any production schedule.

Valve leakage of steam, water and air is not only costly in itself... it slows down production and can, if neglected, lead to serious delays and the loss of valuable time.

Lunkenheimer Valves, of whatever type, with their simplicity of design and built-in lasting qualities, are good insurance against production delays due to valve failure. They are helping many a maintenance crew do a better job easier.

A Lunkenheimer distributor is near you to assist you with your maintenance and operating problems. His facilities and experience are at your call.

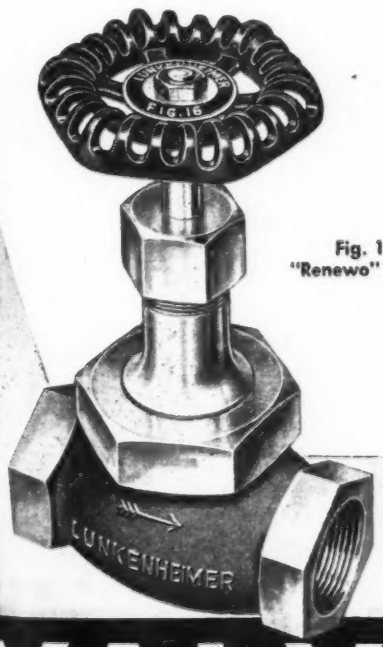


Fig. 16
"Renewo" Globe

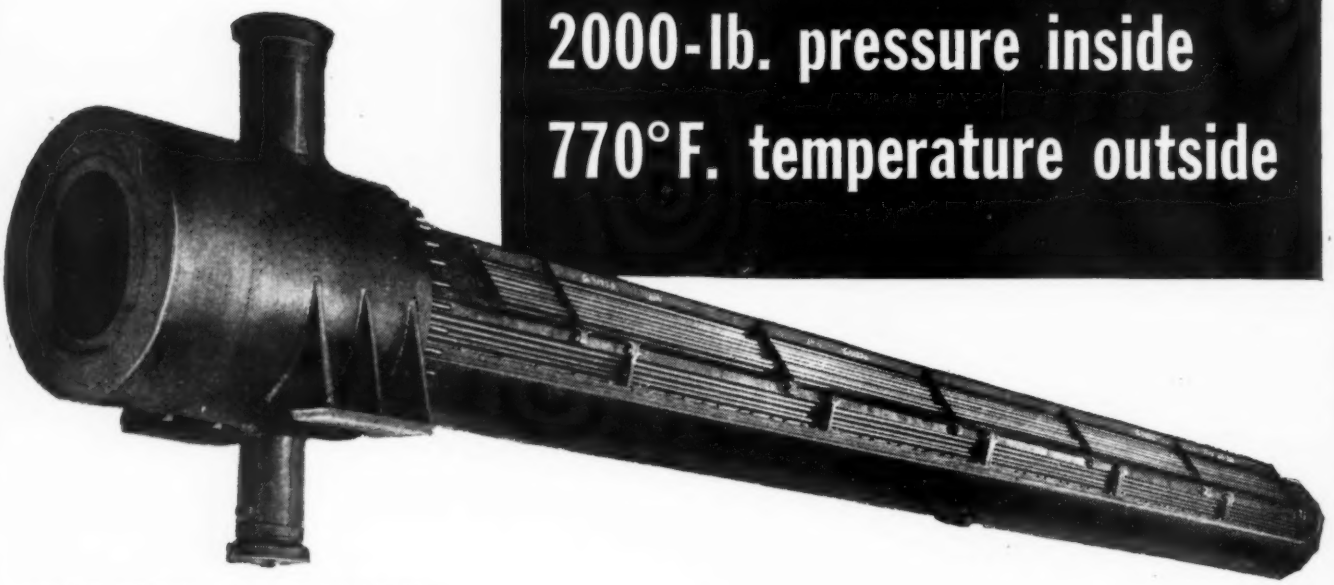
ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI 14, OHIO. U. S. A.
NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 7
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

VALVES

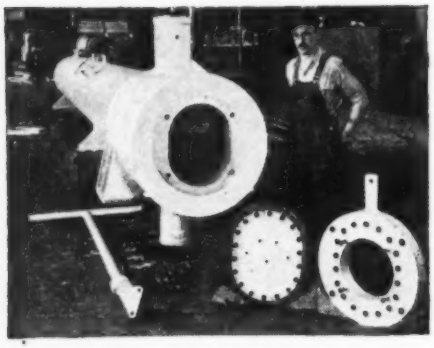
SIMPLICITY OF DESIGN
MEANS EASIER MAINTENANCE

28-118-43

2000-lb. pressure inside 770°F. temperature outside



SHELL REMOVED, showing seamless Monel tubing ¾" OD by .065" wall, calculated to carry 11,500 lbs. p.s.i. unit stress in the tube wall metal. Corrugated joint gaskets are made from Monel sheet.



ASSEMBLED HEATER. Shell carries steam at 770°F. and 650 lbs. pressure. Feed water, while passing through tubes at 2000 lbs. pressure p.s.i. is heated to 475°F.

Water pressure 2000-lb. p.s.i. *inside* . . . steam at 770° F. *outside*.

That's the extremely tough combination met by Monel seamless tubing in boiler feed water heaters, built by the Griscom-Russell Co., New York, N. Y., for the Oswego Station of the Central New York Power Corporation.

These heaters have U-tubes to eliminate necessity for floating head construction as the U-bends take care of differential expansion.

Four heaters with Monel tubing were placed in service at this station during 1940–41.

They have not been idle a moment . . . nor cost a penny for repairs!

Monel performs faultlessly because of its unique combination of properties. It retains strength and toughness at high temperatures. It resists the formation of corrosion film which would decrease the efficiency of heat transfer properties.

Monel is long on life . . . short on upkeep cost . . . and a ready answer to most metal problems in power plant equipment.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings

"27 Times the Power Output"

This report, now being printed, gives the latest information on Monel tubed high pressure heaters, with data on working stresses for non-ferrous materials allowed by new A.S.M.E. Boiler Code for unfired pressure vessels.

Use the coupon at the right for your free copy.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Please send me a copy of the report "27 Times the Power Output"

Name.....

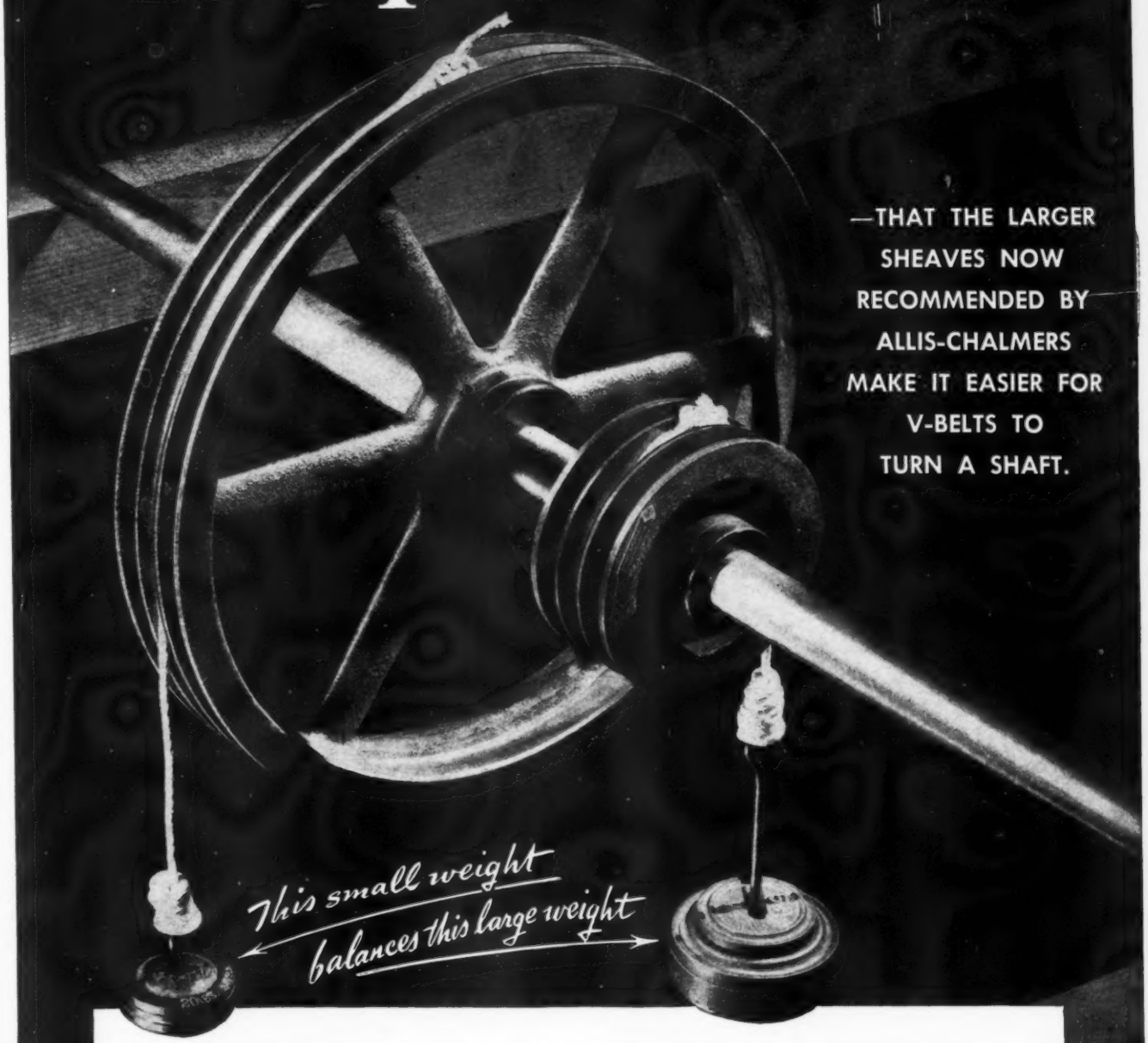
Title.....

Company.....

Address.....

P—5-44

Simple Proof



—THAT THE LARGER SHEAVES NOW RECOMMENDED BY ALLIS-CHALMERS MAKE IT EASIER FOR V-BELTS TO TURN A SHAFT.

YES — THE RADIUS of a sheave is in effect a *lever* . . . and the larger a sheave, the easier it is for V-belts to turn the shaft on which it is mounted.

That's why using larger sheaves where practicable — a wartime recommendation by Allis-Chalmers—often reduces the number of V-belts needed to turn a given load.

You save rubber for the victory effort, save belt cost—and in most cases pay less for sheaves (when number of grooves is reduced, machining time is saved)!

Next time you figure drives, feel free to check with our district office. Or write direct to Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

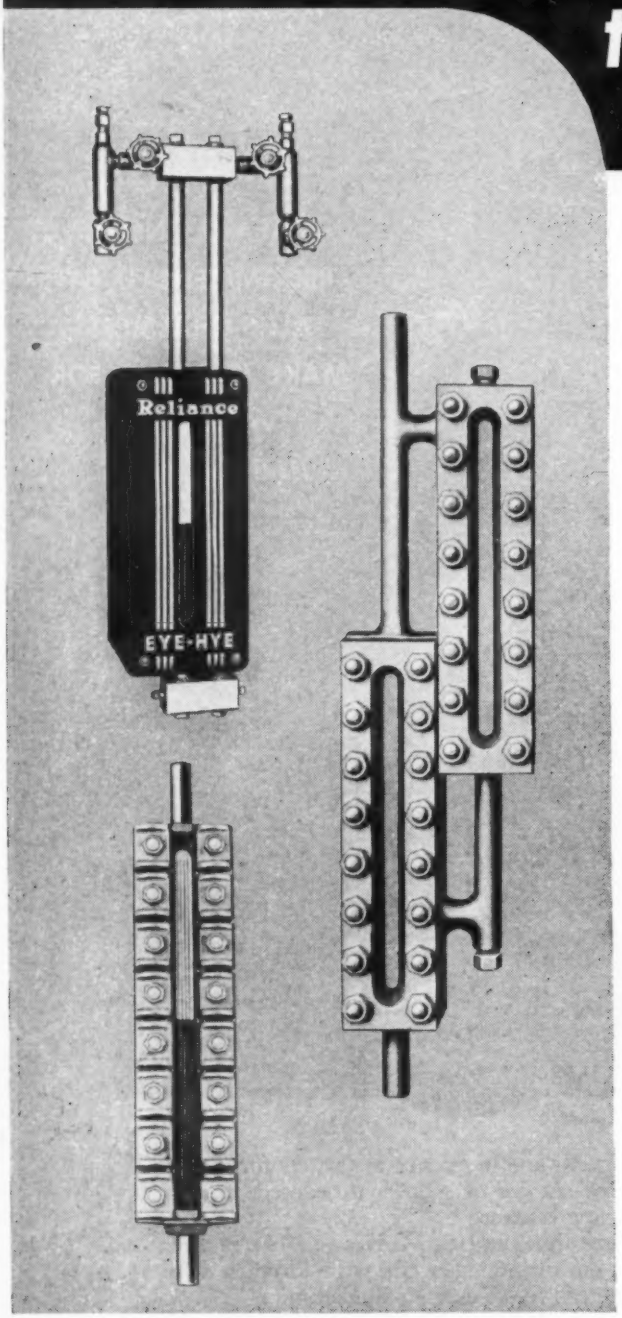
"It Pays to Make Allis-Chalmers your V-Belt Drive Headquarters"

A 1705

Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.

Small equipment that keeps

the dependable Reliance



Don't overlook the *small* equipment that keeps the *big* equipment running smoothly. Reliance Safety Devices are mainly applied to boiler water level supervision, but the well-being of your boilers affects other "big" equipment, as you know. So the selection of high-grade accessories is of major importance. Water level safety means avoidance of expensive accidents that can cripple your production and injure sorely-needed personnel. • For keeping your power plant in the best of trim now, or for your future planning of new or revised power facilities, keep posted on the latest in Boiler Water Columns and Accessories Equip-

60 Years of Boiler Protection

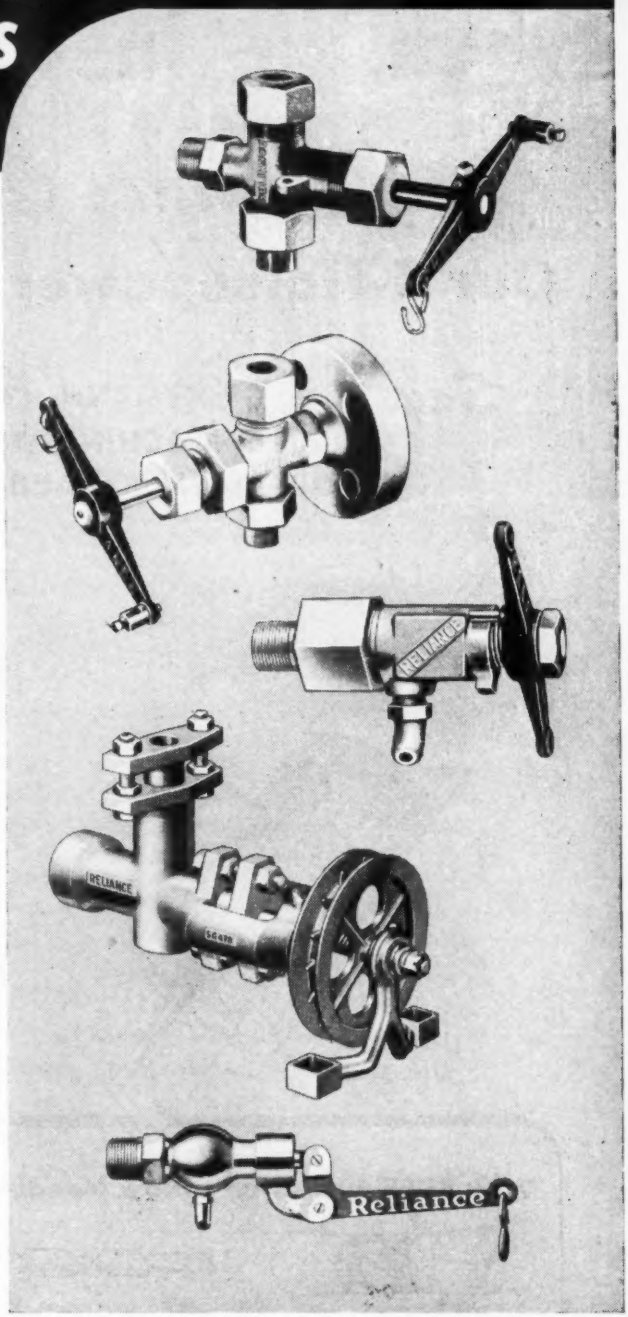
1884-1944 Reliance

...your *big* equipment safe...

...with Boiler Safety Accessories

ment. Reliance has specialized for 60 years—offers you the most complete service in approved devices for water level supervision. • Write to 5902 Carnegie Avenue, Cleveland 3, Ohio, for the bulletins that interest you:

382 Reliance EYE-HYE Remote Reading Liquid Level Indicator
434 Reliance PRISMATIC Water Gage Inserts
437 Reliance Mica-Protected Flat Glass Inserts
418 Reliance Water Gage Valves
438 Reliance Water Column Gage Cocks
414 Reliance Boiler Alarms for pressures to 250 lbs.
415 Reliance Boiler Alarms and Water Columns without alarms for pressures above 250 lbs.



BOILER SAFETY DEVICES

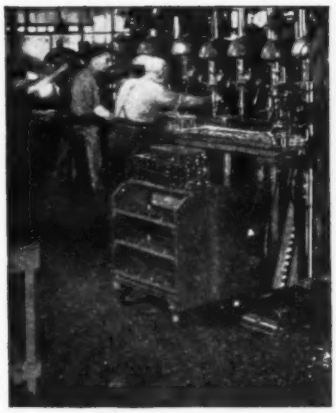
THE RELIANCE GAUGE COLUMN CO.
Cleveland, Ohio

★ ★
Buy More War Bonds

"We Wiped Out Repeated Production Interruptions When We Installed BUSS FUSES

...in the Switch Controlling Our 5-Horsepower Grinders"

Says **A. L. GROFFMANN, CHIEF ELECTRICIAN DOYLE MACHINE AND TOOL CORPORATION, SYRACUSE, NEW YORK**



"OUR battery of 5-hp. grinders is controlled by a 100 ampere fused switch.

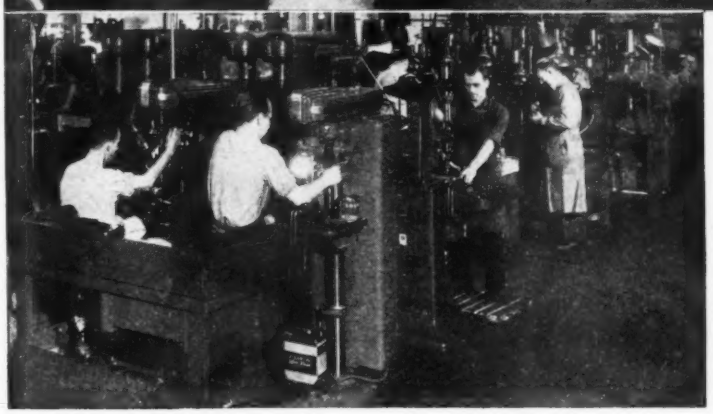
"When several of the machines are started simultaneously, such as when the whistle blows after the lunch hour, a heavy current surge results. This momentary overload repeatedly caused the fuses in the switch to blow and shut down the whole battery of grinders.

"In November, 1943, we installed BUSS Super-Lag fuses in the switch and since that time we haven't had a single shutdown on that important circuit."

Why BUSS Fuses Don't Blow Needlessly

10 FEATURES in the design of the FUSE-CASE help make it possible. *and* **THE SUPER-LAG** development in the FUSE-LINK completes the job.

BUSS Super-Lag



Here is the Steel Products Grinding Department at Doyle Machine and Tool Corporation. A shutdown here stops production and makes operators stand idle—but overhead and wages continue to pile up.

Drill Department. Another spot where a useless shutdown can be very costly in lost production, wasted man-hours, and needless overall expense.

Here is another outstanding example that demonstrates how Buss Super-Lag fuses are helping to keep production running smoothly, how they reduce lost man-hours, and save trouble and grief for electricians and maintenance men.

If you have a problem similar to the one at Doyle Machine and Tool Corporation, doesn't this example indicate how you can profit by the use of Buss Super-Lag fuses?

Buss fuses require no maintenance or periodic inspection. They don't open needlessly. If one opens, you can be sure some condition needs correction. When one opens, it requires less than 45 seconds to renew with an inexpensive link.

Why BUSS Fuses greatly reduce or entirely prevent needless blows

The fuse case is designed to insure good contact on the link, even when the fuse is renewed by an inexperienced person—and it is so designed that vibration or heavy overloads or the constant heating and cooling of the fuse will not permit poor contact to develop. Thus excessive heating, which causes fuses to blow needlessly, is prevented.

The fuse link used is the famous "BUSS Super-Lag." It has lag-plates attached to it. These give it a long time-lag so that unusually heavy starting current or other harmless overloads will not cause the fuse to blow.

Prevent future trouble in your plant—by doing this today

Pass the word along that all purchase records dealing with circuit protective devices should be immediately changed to call for BUSS Super-Lag Renewable fuses. Then, as fuses are replaced or new installations made, your plant will automatically get the benefit of the carefree, trouble-proof protection that BUSS Super-Lag fuses afford.

BUSSMANN MFG. CO., St. Louis 7, Mo.
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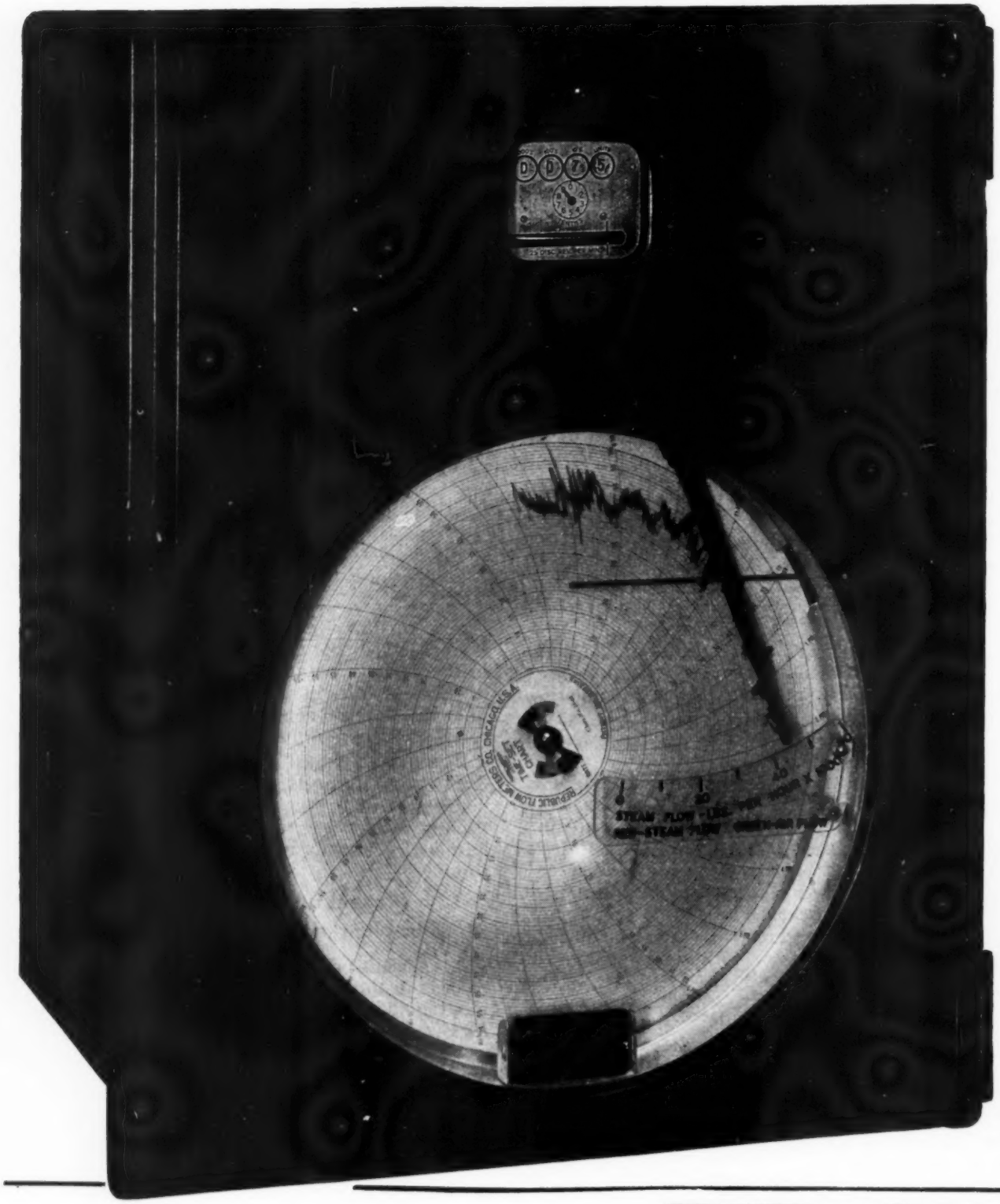
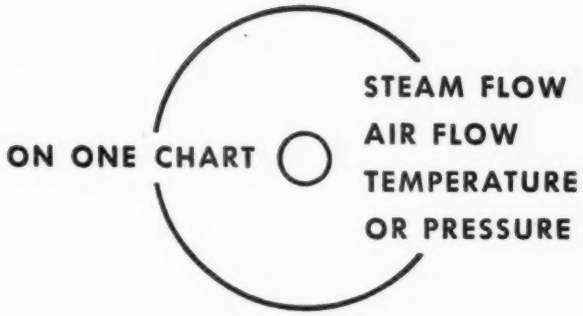
Announcing the



REPUBLIC
INSTRUMENTS
AND CONTROLS

Republic Boiler Meter



● The new Republic Boiler Meter provides, in one instrument and on one chart, all the essential information concerning boiler performance regardless of the size or type of boiler, kind of fuel or method of firing.

The meter indicates, records, and integrates steam flow from the boiler and records rate of air flow for combustion. When the correct amount of air for maximum combustion efficiency is being supplied the air flow pen will record coincident with the steam flow pen, regardless of the load being carried by the boiler.

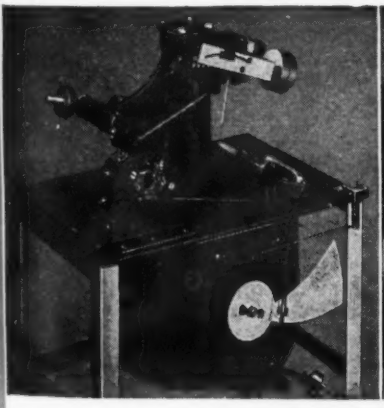
A third pen recording flue gas temperature (or steam pressure) can be added thereby providing the operator with complete information, on one 12-inch chart, relative to the performance of the boiler at any given time.

The Republic Boiler Meter is primarily a boiler operating guide. The two records, steam flow in red and relative air flow in blue, tell the operator instantly whether correct combustion and furnace conditions exist, thereby enabling him to correct faulty conditions when they occur.

The Republic Boiler Meter consists of a standard Republic electric steam flow recorder and integrator and an oil sealed, bell type air flow element.

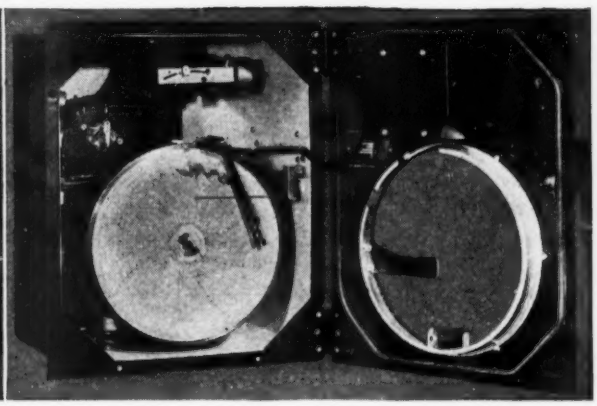
The air flow element consists of an oil sealed bell in a sealed chamber. The motion of the bell is transmitted through a diaphragm seal. This arrangement permits the use of a single bell—the high pressure being applied to the top of the bell and the low pressure under the bell. This arrangement also excludes air and dirt from the oil. The motion of the bell is transmitted to a cam system which extracts the square root, or when adjusted for a particular installation, compensates for chimney action and variable excess air requirements. The air flow pen is attached to the cam system with an adjustable linkage which permits changing the steam flow air flow ratio as conditions may require.

The entire operating mechanism is housed in a rugged steel case and can be easily removed as a single unit by merely loosening two anchor bolts and disconnecting the two air connections. The meter may be either wall mounted or flush mounted on a steel panel. *Write for Bulletin No. 420.*



Meter assembled as one unit on rack ready for calibration.

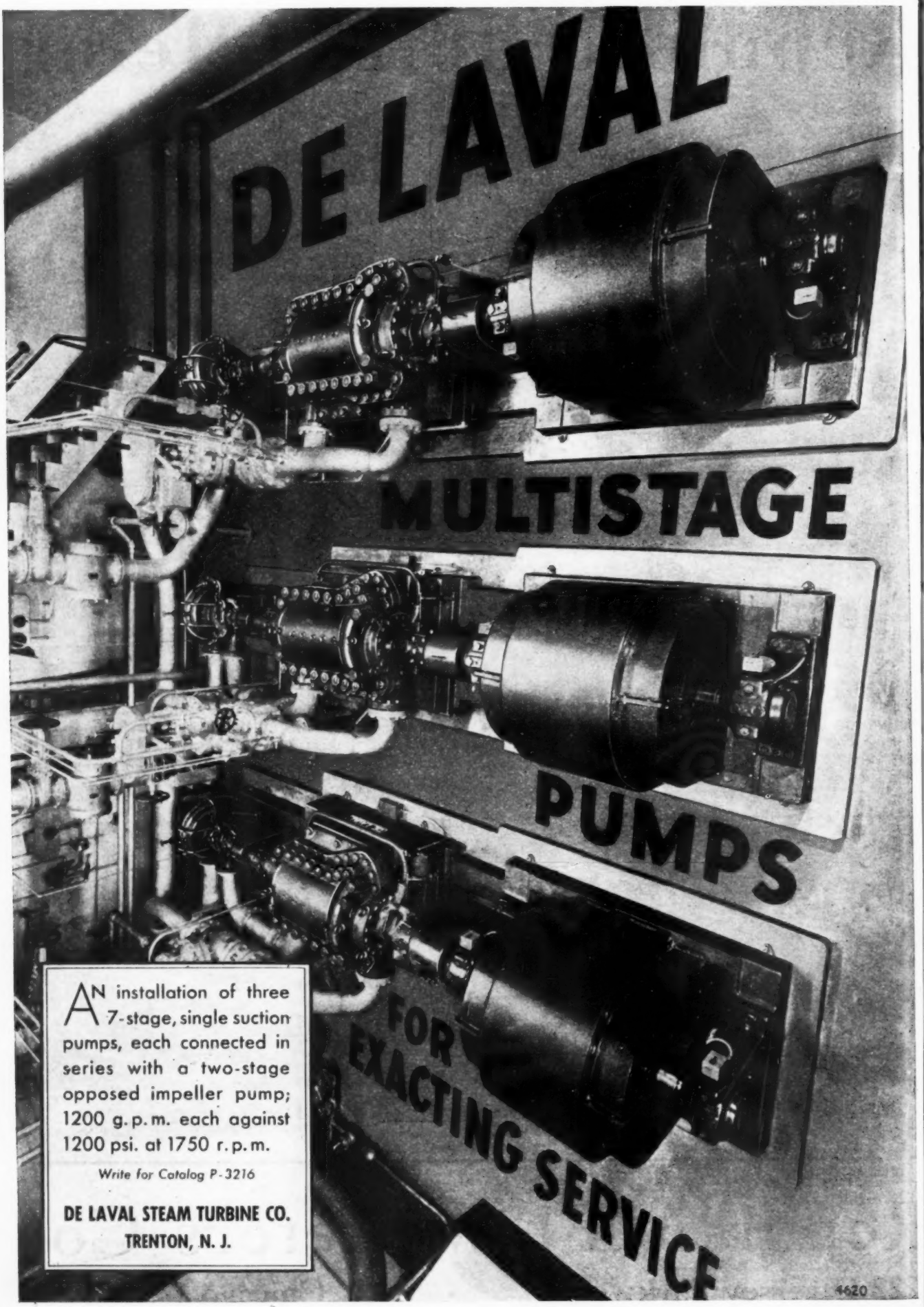
Meter assembly can be easily removed from the case.



Meter with door open showing accessibility of all adjustments and working parts.

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois



AN installation of three 7-stage, single suction pumps, each connected in series with a two-stage opposed impeller pump; 1200 g.p.m. each against 1200 psi. at 1750 r.p.m.

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POWER

MAY, 1944 VOLUME 88, NUMBER 5

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A CROSS-INDEX OF SUBJECTS FOR THE MONTH

PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

FEATURES

		PLANT OPERATING METHODS, MAINTENANCE AND SAFETY	STEAM GENERATION, FUELS, FIRING AND COMBUSTION	TURBINES, ENGINES, AUXILIARIES; HYDRO POWER	DIESELS, GAS ENGINES AND ACCESSORIES	AIR CONDITIONING AND REFRIGERATION	ELECTRICAL EQUIPMENT, ELEVATORS	PIPING, VALVES AND SPECIALTIES	TRANSMISSION, LUBRICATION	STEAM SERVICES, HEATING	INSTRUMENTS, CONTROLS	PUMPS, COMPRESSORS
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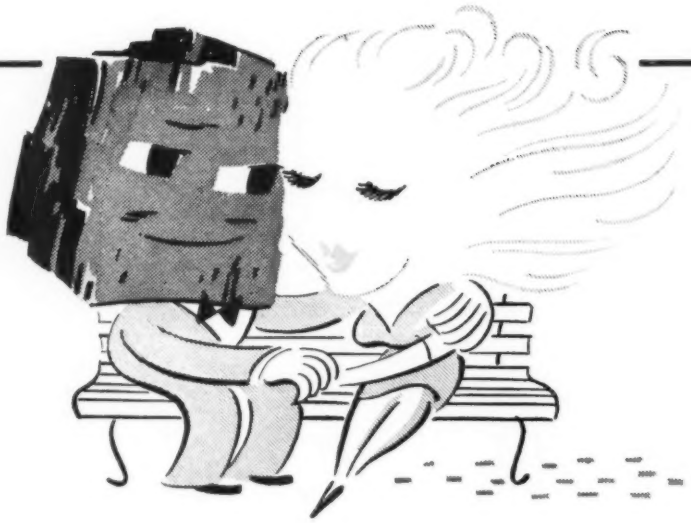
IN A WESTINGHOUSE Link-Grate

coal AND air GET TOGETHER . . .



The fundamental problem of all firing is to bring together the right amount of coal and the right amount of air at the right time—so that all combustible elements are burned. The most efficient stoker, therefore, is one in which this intimate mixture of coal and air takes place continuously and most effectively.

In a Westinghouse Link-Grate Stoker, an undulating grate surface is synchronized with the coal feed to coordinate the flow of coal and air.

This continuous processing of the fuel b results in uniform combustion—not only the Link-Grate surface itself, but also on underfeed section preceding it.

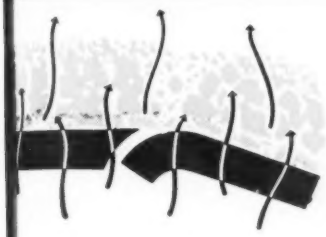
Link-Grate motion improves the entire sto performance . . . keeps the bed porous un all conditions . . . the fire sensitive to air . . . burns any grade of bituminous coal ef tively . . . But you really have to see a L Grate Stoker installation to appreciate amazing record of daily operation. Just your nearest Westinghouse office for c plete details.

WESTINGHOUSE

BEFORE YOU BUY...

Look at the Link-Grate

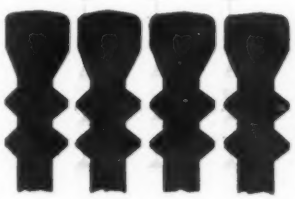
. . FOR MORE STEAM PER POUND OF COAL



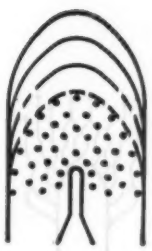
Fuel Bed Processed Continuously

Grates Up—This is the first basic movement of the Link-Grate. It breaks open the fuel bed and thoroughly permeates it with low-pressure air flowing up through the grates. The fused ash in the fuel bed is oxidized and broken into friable pieces.

Grates Down—The second basic movement of the Link-Grate—crumbles and conveys the burning fuel. The fuel bed is kept porous continuously, permitting a uniform flow of gases through the combustion zone. Only low-pressure air is required. This eliminates the need for high-pressure air under the fuel bed and its tendency to blow through the burning coal at thinner spots.



Flow of Air Controlled



Air is controlled in the Link-Grate and tuyerès by projections in each air passage which give the effect of a series of orifices with chambers between. Air passes through the orifices at high velocities, but this velocity energy is largely transformed into static pressure in the chambers. This arrangement provides excellent cooling by air diffusion. It also causes air flow to increase at a lesser rate when fuel bed resistance decreases, protecting grates from the effects of "blowing through".

Link-Grate motion reduces resistance to air flow by keeping the fuel bed porous. Air flowing through the grates is not smothered, but is allowed to support combustion by thoroughly permeating all parts of the fuel bed. J-50450

For more information about Westinghouse Link-Grate Stokers . . . ask your Westinghouse application engineer for Bulletin 3039. Westinghouse Electric & Manufacturing Co., E. Pittsburgh, Pa., Dept. 7-N.

Westinghouse STOKERS

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WESTINGHOUSE

The inside story of how BYERS WROUGHT IRON baffles corrosion in plant services

If you took a tiny section of Byers Wrought Iron no larger than a grain of dust, and enlarged it so its dimensions were magnified 100 times . . . this is how it would look. The close-up gives the inside story of how and why wrought iron resists corrosion, and withstands repeated stresses without fatigue.

The main body is high-purity iron. The darker threads are "iron-glass"—silica slag, representing 2 to 3% of the material by weight, which is distributed in the form of fibers through the matrix.

When corrosion strikes the slag fibers it is halted, for they are immune to attack. It is dispersed over the surface, instead of localizing and causing early failure through pitting. As the action continues, a constantly increasing area of slag surface is exposed, which leaves a constantly decreasing area for corrosion to work on. The fibers anchor the initial film, which in turn shields the underlying metal as a scab protects a wound.

Wrought iron's unusual corrosion resistance helps maintenance men to reduce repairs in dozens of varied services, from breeching, stacks, fuel handling equipment and piping in the boiler room to heating, plumbing and process lines in the plant. This widespread use is based on experience that definitely proves wrought iron's greater durability.

In specifying, it is well to remember that the proven corrosion resistance of wrought iron is the direct result of a unique composition and structure that only wrought iron possesses . . . and that without this composition and structure, no material can honestly claim to be wrought iron.

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POWER

PHILIP W SWAIN, EDITOR • MAY 1944 • ESTABLISHED IN 1882

Coal Fuel for the Gas Turbine?

LOOKING FAR AHEAD, the ultimate marriage of coal fuel and the gas turbine may be the most momentous event in the history of this colorful prime mover. The justification for this comment is the well-founded belief that coal, which has always been the primary heat source for stationary power plants, will increase its margin of cheapness and availability as oil and natural-gas reserves dwindle.

Without coal fuel, the gas turbine may go far as a power unit for ships, locomotives, airplanes and emergency and special plants. Yet it can never dominate the field of stationary power generation until it can break the bonds of fuel limitation and burn coal, directly or indirectly.

Oil from coal has been suggested, but it will necessarily be too costly for this application. There remain at least three possibilities worth considering:

1. Direct transfer of coal-fired-furnace heat through the walls of metal tubes to compressed air (or some other *working fluid*) serving the gas-turbine circuit.

2. Firing pulverized coal directly in the turbine combustor.

3. Firing the combustor with producer gas or "blue" water gas (water gas not enriched with oil).

Of the foregoing, number 1 is mechanically possible and is being investigated. Number 2 is now the object of active experimentation. The mechanical difficulties seem great. Information in hand does not justify further comment.

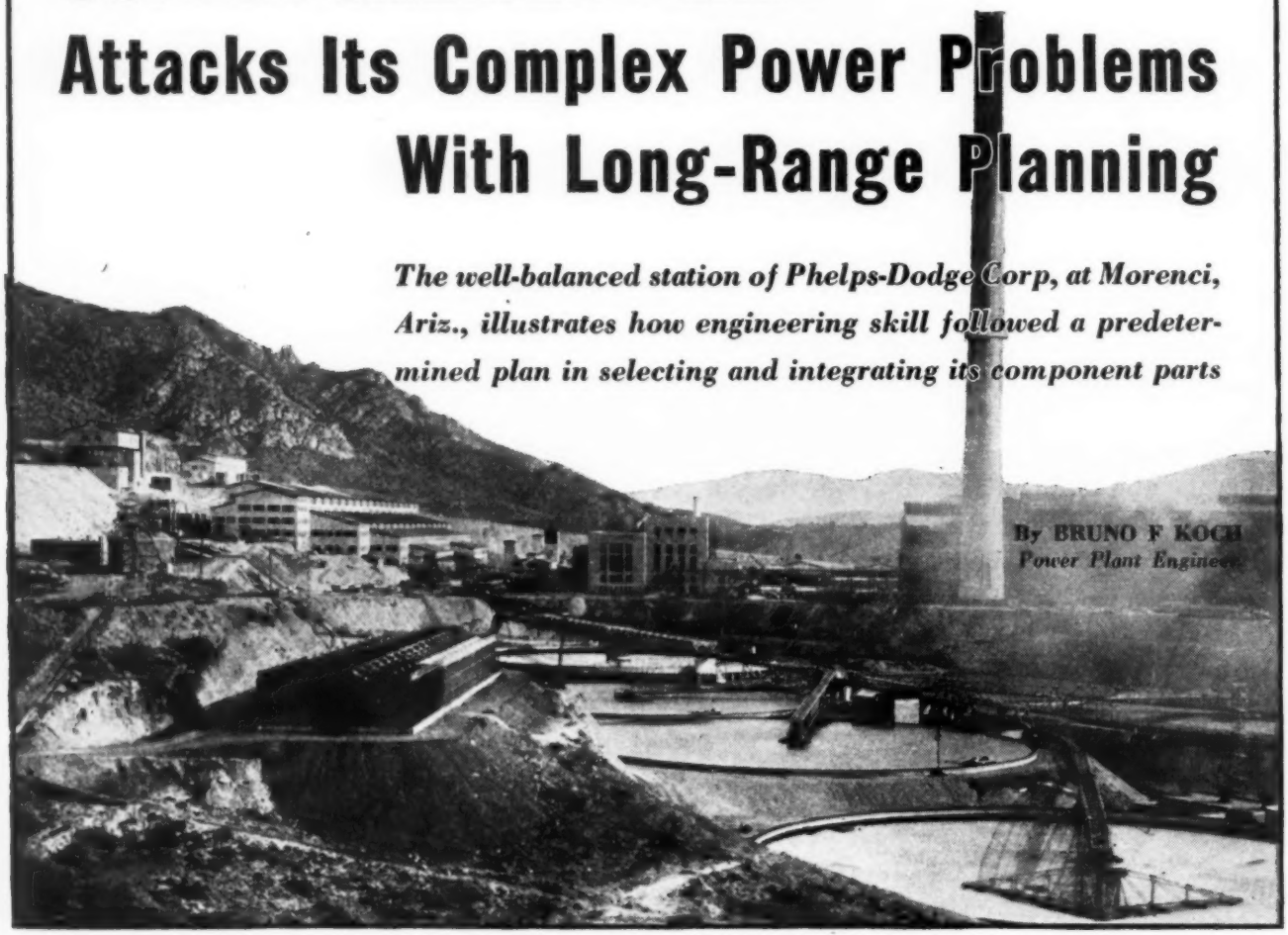
Number 3 remains as a sort of Cinderella, the method almost everybody overlooks, despite some indications of notable suitability. These two gases are discussed in more detail in "Producer Gas—Future Fuel for Gas Turbines?" on page 86, but here are some pertinent facts: Both processes, water gas and producer gas, gasify all the coal except the ash. Both are century old, well tried and fundamentally simple. While water gas is richer, and therefore much better suited to general distribution, the higher efficiency (80%) of the producer may some day favor producer gas for gas turbines if it can be generated at the plant.

One possible reason for the strange neglect of these coal-based fuels in gas-turbine discussions is the common belief that the need to compress the fuel gas lowers plant efficiency, and that this handicap is greatest for *lean* gases, such as producer gas and blast-furnace gas. This fallacy is discussed in the article on page 86.

The designers who are now busy perfecting the gas-turbine plant, as a machine to convert heat units into horsepower or kilowatts, are doing an outstanding job. They should not be expected to divert their energies to an intensive study of gas producers and water-gas generators. Yet somebody, some day, must tackle this job with an ample technical background in combustion, fuel technology and coal processing. The ultimate result may well be cheap heat units for the gas turbine and a bigger field of application for this prime mover.

COPPER-SMELTER PLANT
Attacks Its Complex Power Problems With Long-Range Planning

The well-balanced station of Phelps-Dodge Corp, at Morenci, Ariz., illustrates how engineering skill followed a predetermined plan in selecting and integrating its component parts



By BRUNO F KOCH
Power Plant Engineer

Fig. 1—Power plant (center) houses the generators, and direct-fired boilers and superheaters. Smelter is at right

► SELDOM DOES A COPPER MINE and smelter enjoy either fuel availability for its power plant or adequate and reliable condensing-water supply at reasonably low temperature during hot weather. A public-utility generating station or an industrial plant, on the other hand, often determines its location because these two facilities are at hand. Their lack has a decided influence on station design, as well as on choice and arrangement of component parts. Moreover, the copper mine's plant has to furnish large amounts of low-pressure air and utilize waste-heat steam in varying and uncontrolled amounts.

The Morenci development of open-pit mining requires considerable power to move 50,000 tons of waste rock, haul 50,000 tons of ore daily to the reduction works, pump water for crushing and concentrating plants, and provide power for a full complement of shops.

Smelting copper ore in reverberatories produces large amounts of waste gas at 2000 F. Economy, therefore, dictates that waste-heat boilers convert this gas into power, which automatically determines that the plant be operated by steam.

We first considered and found unattractive a combination of steam plant and diesel engines. In order to establish, for expected operating conditions, the optimum turbine-throttle steam pressure and temperature, we then made detailed calculations for a range from 400 to 750 psi, each for temperatures of 750 F and 825 F. These temperatures were set arbitrarily—the first to avoid carbon-moly steam piping; the second to provide a margin over the final superheater outlet temperature, while not exceeding a maximum of 900 F.

Our two methods of calculation were: (1) Assume as the base a plant using steam at the turbine throttle of 450 psi and 725 F. Then tabulate costs and economies of higher-pressure and/or higher-temperature plants to determine which of the more efficient ones would repay its extra cost in the least number of years. (2) Balance fixed charges against fuel cost on the following premise: Rising steam pressures and temperatures are accompanied by an increment rise in fixed charges, also a decrease in fuel cost. Omitted from our studies were labor and maintenance costs per kilowatthour generated. In general, they may be assumed constant since changes in pressure and temperature, within the range considered, do not affect to any extent a plant's size and arrangement.

The most economical plant would have the smallest annual fixed charges and fuel cost for the pressures and temperatures considered. We concluded, therefore, that with our high fuel cost and need of atmospheric cooling on condenser circulating water, which would affect turbine vacuum, the high-temper-

ature steam would be economical irrespective of the pressure adopted. Further, breaking down and recalculating the data for the range of expected or probable plant loads indicated a close choice between 400- and 850-psi pressure. Slightly better economy of the higher pressure and the expectancy that the reduction works and smelter would operate at full load for many years influenced us in deciding upon the steam conditions.

The National Defense Power Committee, in cooperation with turbine-generator manufacturers, utilities and allied industries, has set up "Preferred Standards for Steam Turbine-Generators." We reasoned that units built in accordance with these standards would lend themselves readily to additions or disposal. Since our calculations for unit sizes most likely to be adopted pointed clearly to NDPC recommended steam conditions, their standard of 650 psi and 825 F total temperature was chosen, also the number of bleed points in that standard. Additional study of an initial 400-psi plant combined with a possible high-pressure topping arrangement did not change our decision.

Modern turbine operation demands close control of steam temperature, not only to obtain test and design efficiencies in continuous operation, but also to guard against approaching the upper limits set by the metals so affected.

Operating on steam at lower than design temperature must also be avoided to minimize erosion of the low-pressure turbine blading by wet steam. This requires that turbine-throttle steam temperature be held reasonably close to the design point and that operators be vigilant, in addition to automatic regulation of dampers or tempering apparatus. Wide changes in feedwater temperature cannot be tolerated. Changes of mass flow and temperature of combustion gases follow variations of boiler load. But their effect cannot be anticipated and more often than not combustion-control systems do not follow as closely as desirable.

Waste-Heat Boilers

In a well-designed and properly operated public utility, continuous observation of indicating and recording instruments controls the variables that act upon steam-turbine temperature, such as changes in load and fuel, feedwater temperature, cleanliness and heat-absorbing surfaces, and heat content and mass of combustion products. However, in a copper-smelter plant, bulk of steam for power comes from waste-heat boilers, output of which depends upon the charge of and amount of fuel used in copper reverberatories and is, therefore, beyond the power-plant operator's control. Nevertheless, the waste-heat steam must be absorbed to avoid wasting it to atmosphere, with attendant loss of water.

Metallurgical considerations dictate grouping of the various sections that comprise a copper-ore reduction works and smelter. Waste-heat boilers, of course, are adjacent to the copper reverberatory furnaces, but dust and sulphureous gases make it desirable to locate the power plant a suitable distance from the smelter. Therefore, a pipeline of considerable length is required to convey waste-heat steam to the turbines.

Number, size and arrangement of waste-heat boilers depend upon number and size of reverberatories. Number and capacity of steam-generation and power units and their auxiliaries, however, is influenced by possible and probable operating conditions. The smelter, for instance, operates continuously while the remainder of the development is on a 6-day weekly schedule. Such operation may generate waste-heat steam in excess of that required to carry the electrical load. To avoid wasting steam it would be necessary to provide extra large feedwater makeup evaporators and storage tanks and steam-driven auxiliaries, besides increasing the turbine steam demand by impairing the vacuum and using steam at lower than normal temperature at times of low electrical load.

More slagging can be expected in the superheater section than in other parts of the copper-smelter waste-heat boilers because spacing of superheater elements is closer and their surfaces operate at higher temperatures. On the other hand, a certain amount of superheat in the steam is required to prevent excessive condensation in the pipeline from smelter to power plant, and to limit the steam's moisture content in the turbine's last stage to about 14% when using only waste-heat steam.

Thus, it is desirable to provide only

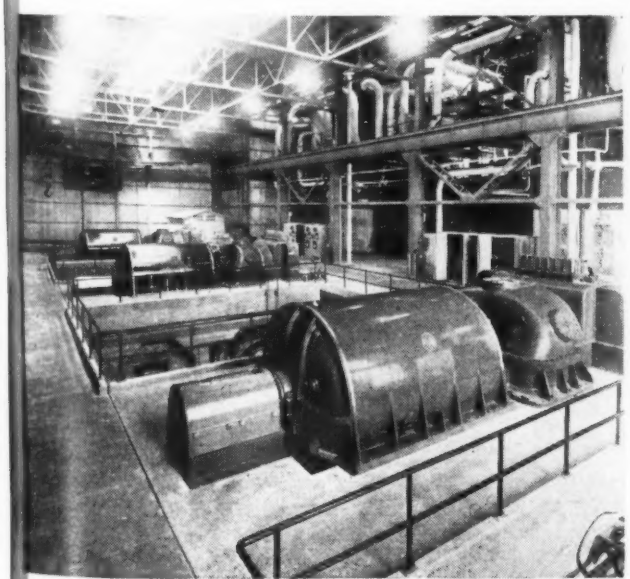


Fig. 2—Original installation of three turbine-driven generators showing island foundation. Boilers, superheaters, deaerators and main steam piping are beyond crane rail at right of generators

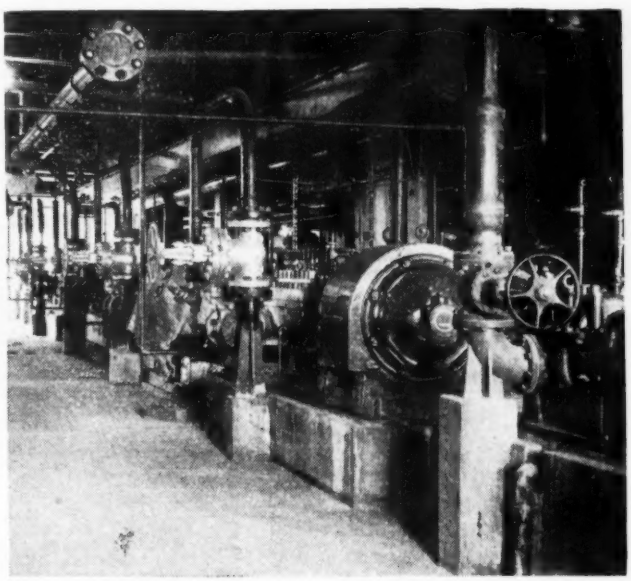


Fig. 3—Convenient arrangement of boiler-feed pumps beneath an overhead trolley hoist facilitates speedy removal of a pump as a unit or lifting of cover for routine internal inspection

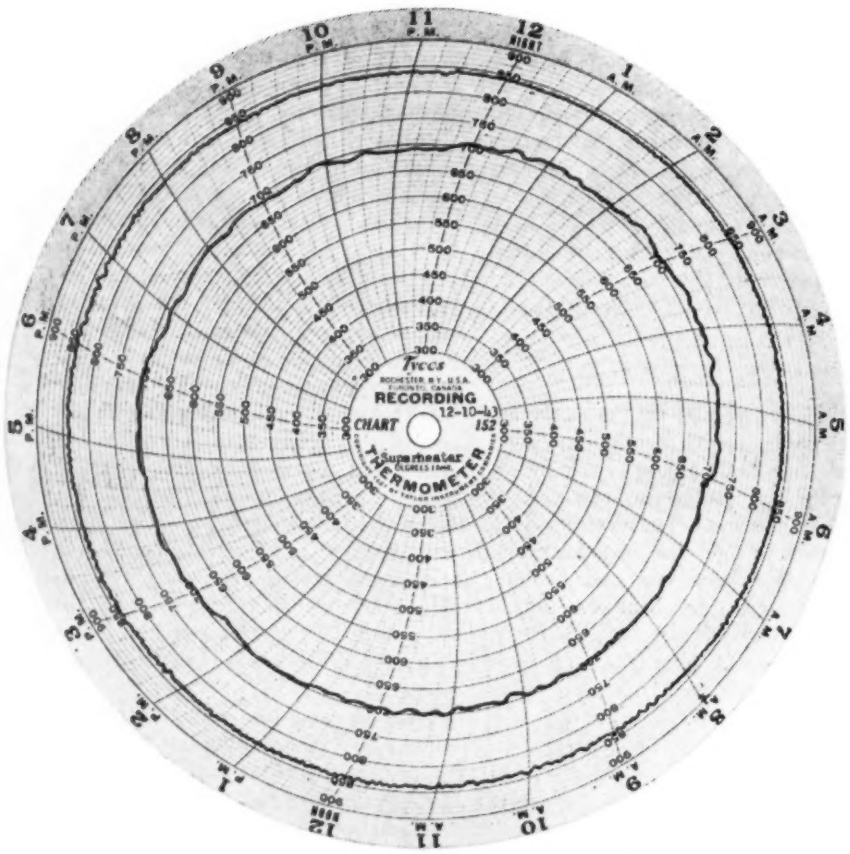


Fig. 4—Substantial evidence that the direct-fired superheater is doing its job. In spite of violent steam flow and load swings steam temperature is held steady

a relatively small superheater in the waste-heat boilers to generate steam of a nominal superheat (approximately 150 F) resulting in a total steam temperature of about 660 F.

For normal week-day operation, this steam must be given a higher superheat. Three schemes considered were: (1) superheating in a direct-fired boiler (2) mixing waste-heat steam with high-temperature steam and (3) installing a separate direct-fired superheater. We doubted that any boiler design could deliver sufficient steam to meet variations in electrical load and, at the same time, superheat a variable flow of waste-heat steam to maintain a reasonably constant steam temperature at the turbine throttles.

Other Complications

We decided also that generating steam in a direct-fired boiler to mix with the waste-heat steam for normal, desirable throttle temperature would require steam from the direct-fired boiler at a temperature in excess of that suitable for an industrial plant. Furthermore, we expect that fluctuations in electrical load and waste-heat steam generation would complicate simultaneous control of the steam generated in a direct-fired boiler, and temperature of the mixture of such steam with waste-heat steam.

Therefore we installed an independent, separately fired superheater through which all steam passes on its way to the turbines. Final temperature is controlled by suitable regulation of the superheater fuel. This installation also avoids generation of additional steam in a direct-fired boiler when not needed for power generation. Results have been gratifying. In spite of violent waste-heat steam flow and electrical-load swings, turbine-throttle steam temperature and pressure are being held constant.

To permit weekend operation on low-temperature steam, a full-sized by-pass around the separately fired superheater with motor-operated valves facilitates quick and easy changeover.

Reduces Flue-Gas Loss

Exit flue-gas temperature of a separately fired superheater is generally quite high, resulting in inefficient fuel utilization. To eliminate that loss, the superheater was paired with a direct-fired boiler by suitable, dampered ducts for exit gas as well as for combustion air. Ljungstrom regeneration air preheaters behind each direct-fired boiler utilize the heat in exhaust gas from the separately fired superheater and a direct-fired boiler to furnish hot combustion air to both.

No attempt is made to control waste-heat boiler-drum pressure, which varies with the flow of waste-heat steam against the automatically controlled pressure in the turbine-supply header. Final throttle steam temperature is governed by automatically controlling the fuel and combustion-air supply to the direct-fired superheater. At least one direct-fired boiler is kept on the line to overcome fluctuations in waste-heat steam generation and electrical load. Hagan combustion and steam-temperature control successfully take care of the rather difficult problem of waste

Fig. 5—Water to and from the cooling tower goes through these spun concrete pipes. Overhead structure is a temporary sluiceway serving the concentrator

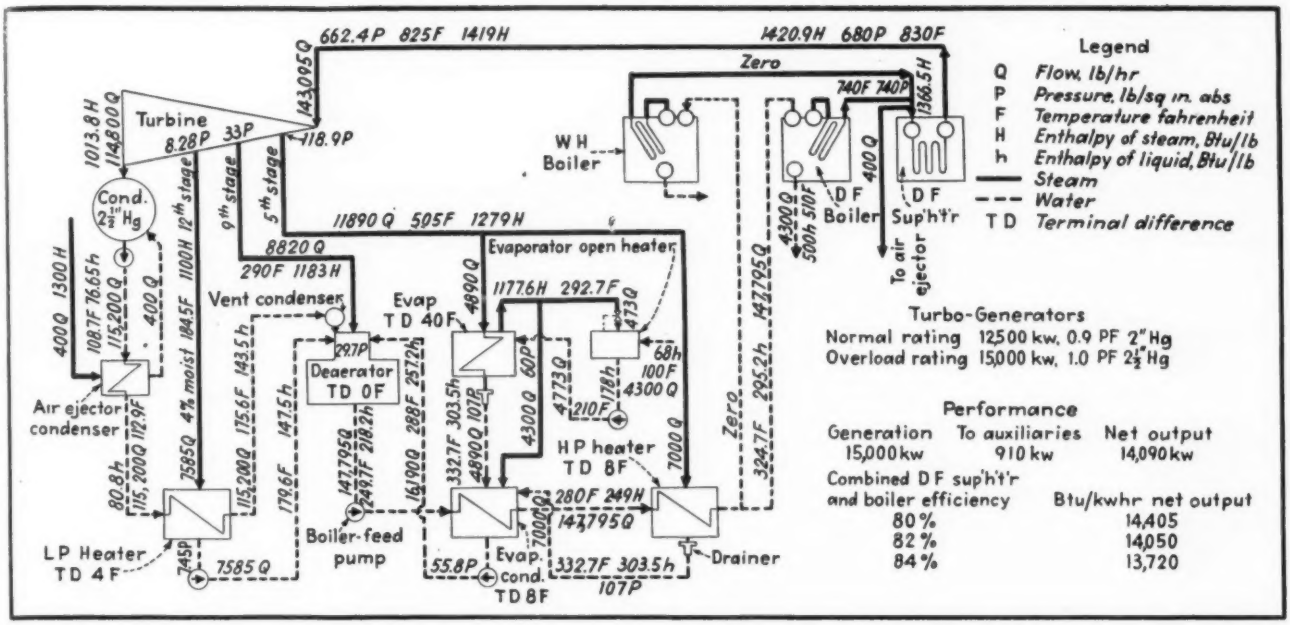


Fig. 6—Heat-balance diagram of the power plant at a generator load of 15,000 kw, 1.0 pf and 2.5-in. Hg backpressure

heat, combined with direct-generated steam and spearately fired superheater. (The combustion control system will be described in an early issue.)

Bulk of electrical current generated hauls ore and waste rock, crushes ore and serves the concentrator. To meet copper-production changes that market conditions demand without jeopardizing plant efficiency, the reduction works have undergone considerable sectionalizing. Three 15,000-kw turbine-generators were originally installed to avoid a large number of smaller units for power generation and yet provide flexibility. All these considerations, with the fact that power-supply failure is highly undesirable, led to installing the unit system of turbine auxiliaries.

For increased economy, relatively high fuel cost and high annual load factor expected justified considerable refinement. Furthermore, since station economy is governed mainly by the available heat head utilized, and since the main turbines are the most efficient elements in a generating plant, practically all auxiliaries are normally driven by electric power generated in main units.

After a voluntary or enforced shutdown, the only outside source of electrical energy available to start up the plant is a diesel unit, held over for that purpose at the old concentrator. But because of its age and location several miles from the plant, its utilitzation is doubtful. Therefore, to make the plant independent of outside power, we decided on turbine-driven auxiliaries for the fourth main generator, now going in.

Intermittent operation of crushers and electric locomotives creates load swings of considerable magnitude. To eliminate their influence on pressure and flow of steam extracted from turbines for feedwater heating, we studied various heating systems before deciding on deaerator-tank pumps and steam-blanketed insulated surge tanks. Arrangement of these tanks, floating on the boiler-feed-pump suction header, created unstable suction pressures. Satisfactory operation and absolutely constant suction pressure, regardless of load swings, have been obtained by subsequent change to feedwater flow through the surge tanks. Water level in them is kept quite high and manually maintained by level-gage indications.

Mercoid alarm switches operate high- and low-water alarms as a safety measure. From the beginning, we visualized an ultimate extension of the reduction works, requiring a fourth prime mover. Choosing only one deaerator would have meant: (1) a greatly oversized unit for the original plant, or (2) serious future complication of piping, valving and operation, or (3) nullification of the intended unit system. Since two turbines will be on the line normally, we installed two deaerators to avoid one machine under full load supplying all bled steam, while the other partly loaded machine operated non-extracting. Hence, with two deaerators,

(*Continued on page* 136)

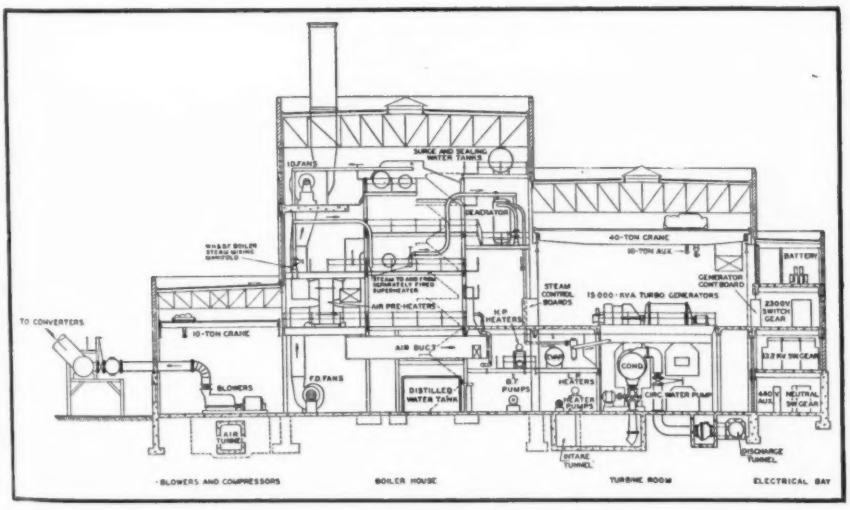
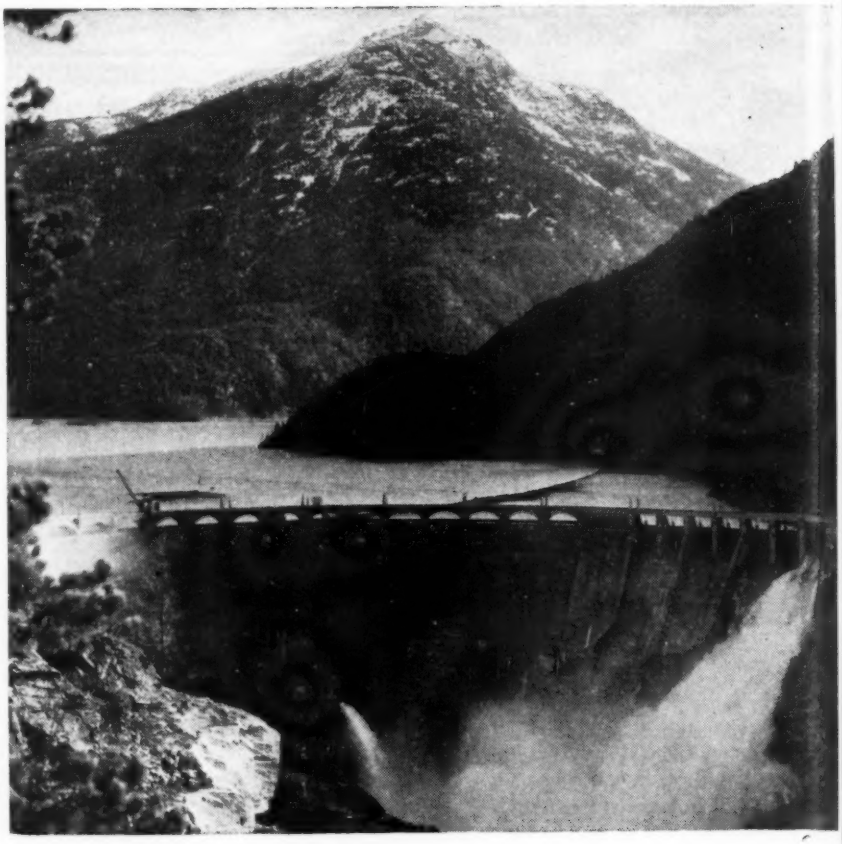


Fig. 7—Section of the powerhouse showing copper-converter blowers, furnace air-supply system, turbine-foundation island construction and electrical bay

NORTHWEST POOL SAVES 100,000 KW

Eleven major power systems, private, municipal and federal, operate generating equipment in five states as though all three million kw were a single integrated unit. Besides reducing fuel use, the Pool saves new machines



By WALTER C HESTON
Engineering Editor, Electrical West

▶ POWER INTERESTS of the Pacific Northwest have created a super power pool unequaled from the standpoint of resources and economic benefits, as well as complexity. The interconnection draws from more than three million kw in the states of Oregon, Washington, Montana, Utah and Idaho, through a web of 13,000 miles of transmission lines.

This war-born pool has done some important team work:

1. Total power resources of five Pacific Northwest states have been made available for serving the entire load of the area, thus assuring ample power.

2. 100,000 kw of additional power could *immediately* be supplied to war industries. Spare generating capacity in regions with little war load is, in effect, shifted to war centers where vitally needed.

3. Conservation of critical resources includes: Fuel oil and coal saved by substituting hydro energy for steam power; copper, steel, manufacturing facilities and manpower saved through eliminating the need for about 100,000 new kw.

4. Breakdown service can be supplied to any system during storms or generating-equipment failure.

5. Power continuity is assured to war industries even in the face of major transmission or generation breakdown.

6. Power is traded back and forth and stored in reservoirs to conserve every possible drop of rainfall.

7. A diversity in system peaks is gained because the eleven major systems are in different time zones.

8. Scheduling of maintenance outages is programmed so that a minimum of generating capacity is out of service at any one time.

Eleven Power Systems

The Pacific Northwest Power Pool was created in July, 1942, by voluntary action of eleven major power systems. They comprise all private, municipal and federal systems in the region, that is, Portland General Electric Co, Northwestern Electric Co, Tacoma City Light, Seattle City Light, Puget Sound Power & Light Co, Bonneville Power Administration, Washington Water Power Co, Pacific Power & Light Co, Montana Power Co, Utah Power & Light Co, and Idaho Power Co.

In 1915, private utilities of the Northwest pioneered in interconnection of power systems. First major step in interconnection came in 1918 when Puget Sound Power & Light, in western Washington, and Washington Water Power Co, in eastern Washington, were interconnected through the 110-kv line of the Milwaukee railroad. In 1923, Seattle and Tacoma municipal plants were joined, and a number of other system interconnections made until, in 1941, a pool was formed of the six Electric Bond & Share systems in Oregon, Washington, Montana, Utah and Idaho. More than a year's operation of this pool lent valuable experience when the present super pool was formed.

In July, 1942, only a few comparatively short lines were needed to tie in the Bonneville Power Administration system with existing interconnected systems, thus creating the present 11-member pool. The systems are grouped into ten units for operation, with smaller systems and large industrial plants represented by some one of the members. Fig. 4 shows the pooled systems, with resources and tieline capacities.

Load and resource diversity in such a large area, roughly one sixth of the nation, has made possible adding 100,000 kw of load to the combined systems without building a single power plant. Not alone was the power made available *immediately*, but there was a saving of not less than $25,000,000, representing steel, copper, manufacturing facilities and manpower that would otherwise have been required.

There is considerable load diversity in the area. In Montana, Idaho and

Fig. 1 *(left)* Excess water that formerly had to be spilled at some seasons is now turned into kwhr for use anywhere in the pool while water is stored at other reservoirs having available pondage. This is Diablo Dam of Seattle City Light, one of Northwest Power Pool hydroelectric resources on the Skagit River

Fig. 2 *(below)* Under present methods of pool operation, Oregon hog fuel or sawmill refuse can be converted into electrical energy and stored in some reservoir in Utah or Montana, a thousand miles away. This giant pile at Portland's Station L is just another 31 million kwhr from the dispatcher's point of view

Utah, systems serve large mining loads, while on the Coast, loads are largely domestic, commercial and industrial. The different time zones of the systems also stagger peaks advantageously. Chief benefit of the Pool, however, is the great diversity in hydro resources. Precipitation varies greatly in the many watersheds from the Cascade Mountains to the Rockies.

The bulk of generation is on streams flowing into the Pacific. But Utah Power's plants are in the Great Salt Lake watershed, and most of the plants on the Montana Power system, as well as the Fort Peck federal plant, are on the Missouri River, which as a Mississippi tributary empties into the Gulf of Mexico at New Orleans. It fascinates the imagination to realize that the energy from these widely separated watersheds all finds its way into a common pool.

Hydro Storage

Many of the plants east of the Cascade Mountains have large reservoirs, some of them natural, where large blocks of stream-flow energy from the coastal streams can be held for later use during low-water periods in western Oregon and Washington. Steam energy, also, especially from plants using surplus hog fuel or sawmill refuse on the Coast, is frequently stored in reservoirs in eastern Washington and Montana. Thus the Pool, with 150 power plants—130 owned privately and 20 publicly—with total generator rating of 3,353,500 kw, has tremendous resource flexibility.

When the Pool was formed the following set of rules, or guiding principles, was drawn up to govern operation:

1. Interchange transactions are made in accordance with contracts then in effect between members, but these should not limit the pooled systems from realizing the resources needed to carry primary loads.

2. All members cooperate to provide capacity for carrying the maximum anticipated load of the pooled systems, after which maximum economy of power production for the systems governs operation.

3. Each member, first, reserves to itself as much of its own power and energy as is needed for its primary load without depending upon surplus interchanges with neighboring systems and, second, cooperates to assist adjacent systems in meeting power and energy needs.

4. Delivery of surplus hydro or fuel energy is made to members who: first, currently need it to carry load after all their own resources are utilized; second, can use it to reduce fuel consumption; and, third, can store it in controllable reservoirs to provide additional primary resources for the pooled systems.

5. Energy from steam stations should be used in the order of increasing relative costs (with consideration to system losses in arriving at these costs) unless fuel conditions are critical.

6. Losses in a system caused by interchange transactions are the difference between actual losses and those that would have occurred had the transaction not taken place, or had the energy involved in the interchange not been generated.

All Voluntary

One of the most important factors in success is that all actions are voluntary. The organization set up to handle administration has contributed materially to success. All operations are in the hands of a committee, composed of authorized representatives—one from each pool member, who has full authority to act for his management.

Meetings, at intervals of about a month, are rotated around the territory. The authorized representative may bring members of his organization when special problems are discussed. A coordinating committee, described later, also attends. At meetings, members dis-

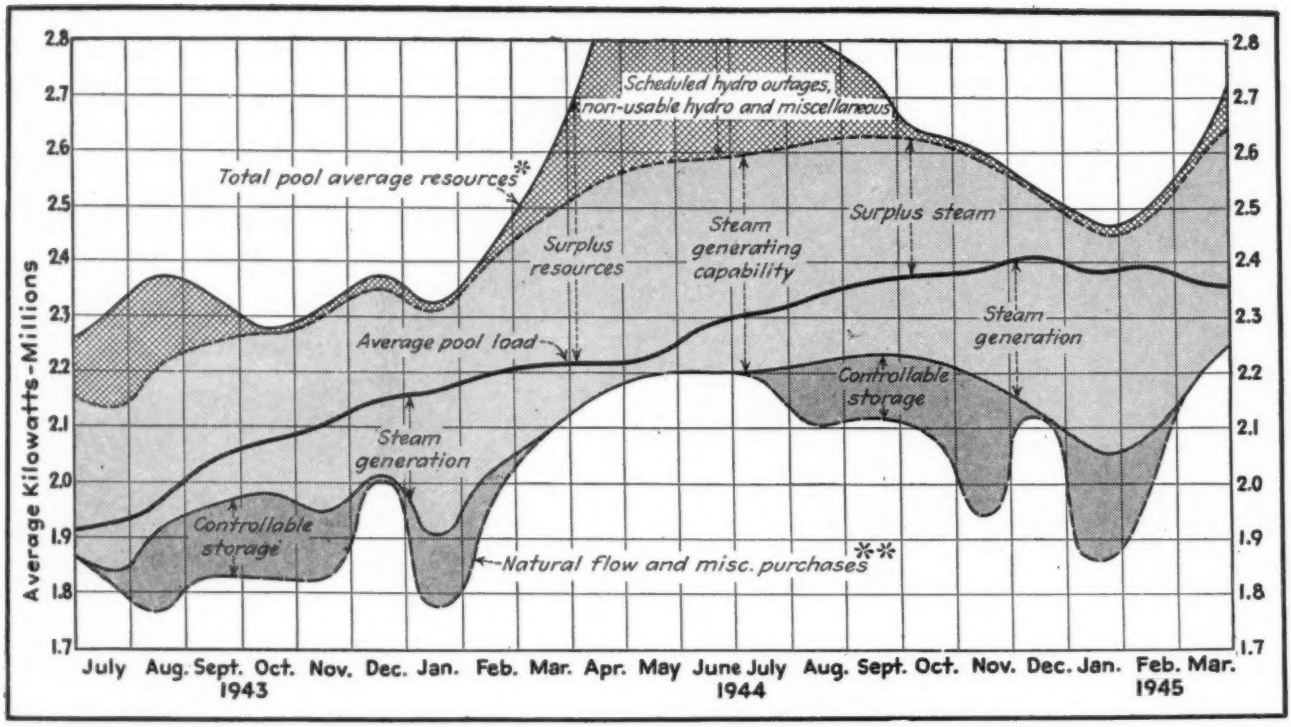


Fig. 3—Master graph of Northwest Power Pool loads and resources during a 2-year period. Similar charts are prepared for each operating system, covering estimated operation of fuel-burning plants and storage reservoirs in the area

cuss operating policy, check resource studies, schedule maintenance outages, plan elimination of bottlenecks, handle telemetering and communication problems.

In a weekly telephone-conference call, the committee discusses the past week's operation, plans for the next week, checks maintenance schedules, and handles important problems that arise between regular monthly meetings.

A coordinating committee of four engineers in a central office devotes its entire time to pool operation. Besides coordinating all resource studies, telemetering and communication problems, it cooperates in studies of real and reactive power flows, keeps a running check on operations and issues necessary reports and minutes of meetings, including the telephone-conference call. This committee first made a resource study of the Pool as a whole, from which a 2-year program was made up. This covers estimated operation of fuel-burning plants, establishes so-called *rule curves* to govern day-to-day water elevation for every reservoir and sets up a coordinated maintenance program. The master resource graph for the Pool is shown in Fig. 3. Similar graphs were prepared for each individual system.

Storage of water in each other's reservoirs to conserve resources, which is one of the most important Pool functions, could become complicated and a barrier to successful operation if it were not for the conciliatory spirit of all members.

Members have the right to store energy in each other's reservoirs, subject to the owner's approval and an agreement covering all phases of return, sale and use. When water must be released, the highest cost energy is spilled first. A reservoir may store water for several members so it is convenient to think of it as stored in layers. In general, the last man in is the first whose water is spilled, but this custom may be altered if cost of energy that caused the storage is a factor. To avoid complication in storing water, hydrostatic gains and losses and evaporation are factors that so far have not been considered.

Power Accounting

Scheduling power interchanges and accounting is complicated. Systems in the western portion of the Pool have several interconnections with each other, containing several loops, and loops inside of loops. Power flows do not respect line ownership and part of a scheduled exchange between two systems may pass through other systems.

Method of solving this problem is unique. Accounting is handled much as in a banking clearinghouse, except that no central agency keeps track of debits and credits. However, the coordinating committee does keep a running check and issues weekly reports by which a member may check his account.

In lieu of a clearinghouse, each member balances accounts with his neighbors with whom he is physically interconnected. Debits and credits of the monetary system are displaced by plus and minus deviations from scheduled interchanges.

All scheduled interchanges are on an *hourly* basis and log sheets show these schedules in thousands of kilowatts. Thus, if an operator schedules an interchange of 30 megawatts with a neighbor, it means a schedule of 30,000 kwhr since 30,000 kw for 1 hr = 30,000 kwhr.

An important point in billing is that all payments are on the basis of the *schedules* and not on actual interchange. This is reconciled, however, as will be seen. At the end of the hour, watthour meter readings are phoned in from distant points to each dispatcher and the algebraic sum taken. The result is compared with the scheduled delivery and any difference, plus or minus, is called *deviation*. Hourly deviations may be high, but systems are operated from hour to hour and day to day to keep deviations small and tending always toward zero.

Thus, when a system's deviations for all ties are exactly zero, it will have received exactly the kilowatt hours it paid for under the scheduled billing, right down to the accuracy of the watt-

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* Not including additional energy in reserve storage
** Including non-controllable storage. Excluding negative drafts on storage and non-usable hydro energy

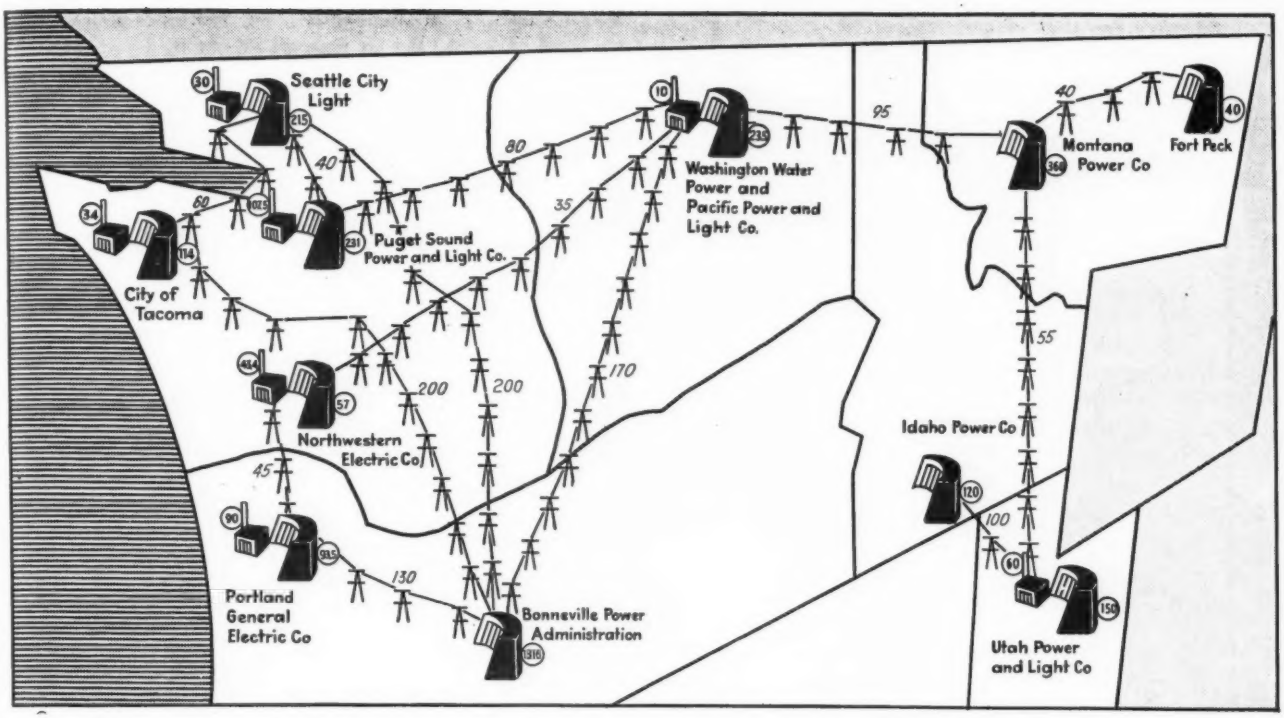

Seattle City Light
Puget Sound Power and Light Co.
City of Tacoma
Northwestern Electric Co
Portland General Electric Co
Bonneville Power Administration
Washington Water Power and Pacific Power and Light Co.
Montana Power Co
Fort Peck
Idaho Power Co
Utah Power and Light Co

Fig. 4—Eleven major systems with a capacity of 3,353,500 kw comprise the Pool extending from the Pacific Coast to central Montana. Smaller systems and a number of industrial plants also contribute. Numbers beside plant symbols indicate capacity in megawatts

hour meters themselves. A little thought shows that clearing accounts between neighbors accomplishes the same thing as clearing through a central accounting staff. Thus, the *pool* account is always kept straight.

Each operator makes up his schedules of desired receipts and deliveries a day or more in advance and exchanges them with his neighbors. These schedules constitute hourly contracts, and billings are based upon contracts in effect between the parties to an interchange.

Telemetering, or transmitting meter readings from distant points to a central dispatcher's office, is almost indispensable. Without it, scheduled power deliveries are maintained with difficulty because the dispatcher must work more or less in the dark during the hourly interval between phoning in of readings and calculating of results, which takes from 10 to 20 min. Of equal importance is automatic tieline load-control apparatus used in conjunction with telemetering signals. This device enables the dispatcher to set his schedule at the beginning of the hour and it is then automatically maintained.

All members agree to install telemetering and tieline load control, but because of slow deliveries only about half are equipped now. Automatic tieline load control performs another important function. It makes possible operating tielines much nearer to their limits of electrical stability. In fact, their loading can be increased as much as 50% under automatic control.

Frequency control of the Pool is delegated to some one plant, usually the Grand Coulee plant on the Bonneville system because of its 108,000-kw generators. One such unit normally handles average load changes of about 90,000 kw. Coulee has automatic time-frequency control equipment which maintains the electric time of the pooled systems within very close limits.

Studies were made on calculating boards to determine stability limits of lines and duties on oil circuit breakers, and to locate bottlenecks. A number of these studies were made on Bonneville's analyzer and the Pool itself is often used at night or on Sunday to check an operating condition that must be met later.

Good Stability

Some oil circuit breakers had to be replaced and others modernized to provide necessary interrupting capacities under pool operation. Only on rare occasions has the system broken up because of instability. The Pool has sufficient stability to withstand the loss of lines carrying as much as 200,000 kw, as actually occurred on one recent occasion.

Flow of reactive power is a problem not fully solved. Several synchronous condensers and a number of static capacitors have been installed. Coordinated synchronous condenser operation and the segregation of station buses have also been used at times.

Communication and telemetering problems are under constant study. Facilities for communication, consisting of private and leased wires, long-distance Bell and transmission carrier, while quite workable, still leave room for improvement. Completion of planned telemetering and load-control equipment will greatly aid operation and permit the ultimate in utilization of the varied resources.

So far, each member has absorbed the losses in his own system, because the Pool considers that it is a give-and-take proposition, especially during the war, and that losses probably about balance out as between systems. However, the matter may be gone into later as losses from wheeling, or passing power through a system for another member, may be appreciable.

Successful operation of such a large and complicated interconnection reflects credit upon all who have had a part in the undertaking. J A Krug, director of the Office of War Utilities, and his staff have rendered invaluable aid and may well be proud of their wartime power-pooling program. So outstanding have been the benefits of this and other pools throughout the nation that a new era in power distribution has been ushered in that will undoubtedly be continued after the war.

Float Control Holds Submergence On Condensate-Pump Suction

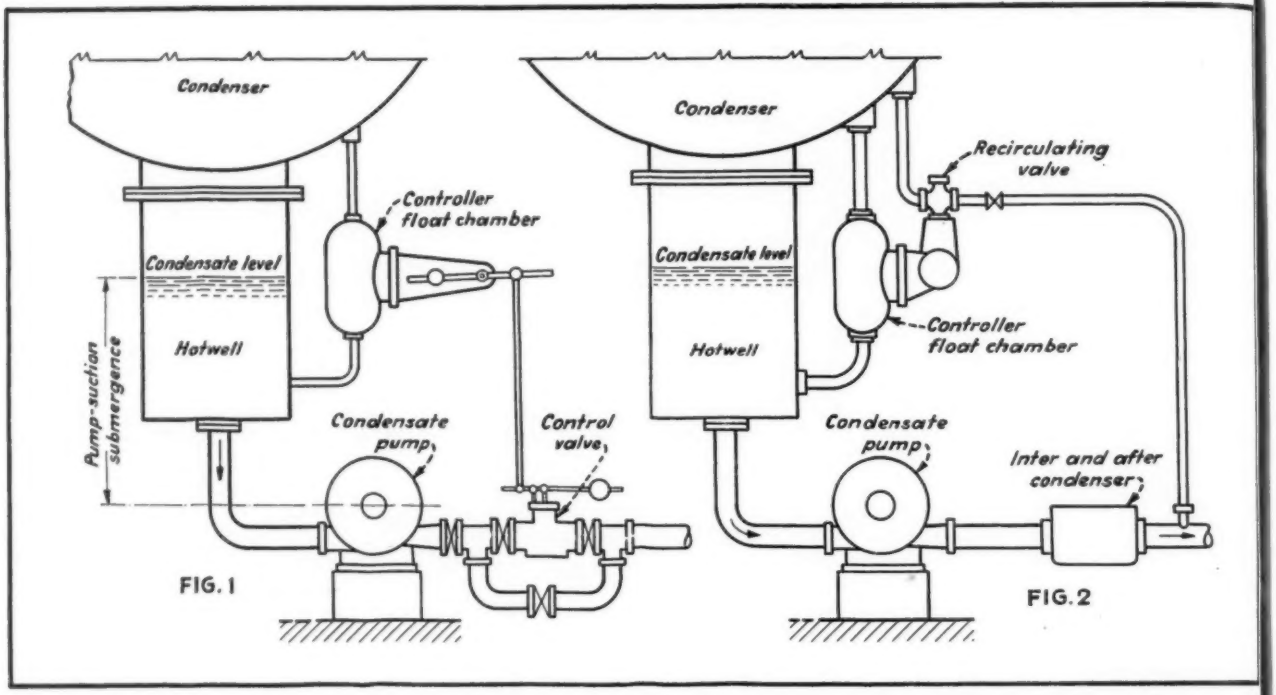


Fig. 1—Float control positions valve in pump discharge to maintain correct condensate level in hotwell. Fig. 2—Float operate bypass valve in the return line to recirculate part of pump discharge to maintain correct suction submergence on the pump

► CONSTANT-SPEED CONDENSATE PUMPS usually operate best at rated capacity and head. On surface condensers rated capacity-and-head conditions exist at only one load—normally, rated turbine load. Variations in turbine load cause approximately proportionate changes in steam and condensate flow. The pump must remove condensate as fast as it enters the hotwell; therefore, under normal operation, it must take care of wide variations in capacity and head.

At rated capacity and head, a condensate pump is designed to operate at a given submergence of its suction; the static difference in elevation between hotwell water level and pump center line. When condensate flows from hotwell to the pump suction, losses occur caused by friction of the liquid in the suction pipe and pump-casing entrance, shock at runner entrance, velocity head, etc. When water reaches the pump runner, practically all available submergence has been lost and the runner-entrance pressure is close to vapor pressure of the water.

Minimum required submergence on a pump at normal capacity equals a head necessary to overcome all losses, plus sufficient pressure at the runner entrance to prevent water vaporizing. When condensate flow decreases, suction-passage losses also decrease and required submergence is less. As most losses and velocity head vary approximately as the flow squared, the required submergence drops more rapidly than does the flow.

System Head

System head (head that the pump must develop for a given discharge) falls off with a decrease in condensate flow. Characteristic capacity-head curve of the pump, however, generally shows a head increase for reduced capacity. These opposing conditions cause the pump to reduce hotwell water level as flow is reduced to where vapor forms in the pump. Then it has to handle a mixture of vapor and liquid, but in terms of vapor-liquid mixture the pump probably develops the same capacity-head curve as for condensate. The mixture density, however, is reduced in proportion to the vapor quantity handled so that when measured in terms of condensate the pump capacity and head are lowered.

Changes in fluid density, to bring pump head into balance with system head requirements, occur automatically. As the water-and-vapor mixture moves through the pump, pressure increases on the vapor bubbles and they condense. Since there is little cushioning gas mixed with the vapor, the bubbles collapse violently. If a bubble collapses adjacent to the runner or casing wall, water rushing to fill the bubble's space gives the wall a heavy localized blow causing a crackling noise. In severe and prolonged actions like this, known as cavitation, runner metal is eroded.

To eliminate these objectionable features and obtain desirable ones, explained later, frequently condensate pump performance is controlled. Depending on flow conditions in the condensate system, control of a constant-speed pump is commonly obtained by throttling the pump's discharge or recirculating part of the condensate, or by a combination of throttling and recirculating.

For either throttling or recirculating

Arnold S Frank, condenser engineer, Westinghouse Electric & Mfg Co, explains condensate-pump operation (1) without hotwell-level control (2) with throttling control and (3) with recirculation level regulation, giving the advantages and disadvantages of each system

COMPARISON OF THREE TYPES OF CONDENSATE-PUMP CONTROL

NO-CONTROL

Advantages:

1. System has the simplest arrangement of equipment and piping
2. Power required for a given condition is less than for the other systems

Disadvantages:

1. This system cavitates, which usually adversely affects pump life
2. If flow to pump becomes very small, submergence may drop so low that pump becomes vaporbound
3. System has no control of minimum flow through auxiliaries
4. System has no control of condensate level in hotwell

THROTTLING

Advantages:

1. Cavitation is usually eliminated
2. Power required is usually less than for recirculating controller. Required power usually falls as capacity is reduced
3. Condensate level in hotwell is maintained practically constant

Disadvantages:

1. Pump must be constructed to develop additional head for friction loss in the valve when wide open
2. Needs additional equipment and has piping complications
3. Danger of water overheating the pump when operating at or near shut-off
4. No control of minimum flow through auxiliaries

RECIRCULATING

Advantages:

1. Reduces cavitation, although it may not be eliminated entirely
2. Danger of overheating pump is eliminated
3. System passes the minimum flow required by auxiliaries
4. Reduces extreme variations of condensate level in hotwell

Disadvantages:

1. Additional power required to recirculate water
2. Needs additional equipment and has piping complications
3. With more than pump rated-suction submergence available, if controller were set at highest submergence of 4 ft, Fig. 3, the pump would operate near point *C* and its power would then exceed 100% normal and might overload motor, as shown at point *G* on the pump-brake-horsepower curve

control a float chamber connects to the hotwell. Within the chamber a float, actuated by hotwell condensate level, opens or closes a valve, as in Fig. 1 and 2.

With throttling control, Fig. 1, the controller actuates a valve in the pump discharge line. When condensate level in the hotwell drops, the valve partly closes and remains so until the condensate level returns to normal. Thus, condensate level remains practically constant and the pump operates on its normal characteristic capacity-head curve with a reduction in possible cavitation.

With recirculating control, Fig. 2, a valve is actuated in a line between pump discharge and the condenser. As condensate level drops in the hotwell the valve opens to permit part of the condensate to recirculate back to the hotwell. The valve remains open until condensate level returns to normal as determined by the controller. With this arrangement, flow through the pump may vary between normal pump capacity and the amount that can pass the recirculating valve. Hotwell level

(*Continued on page* 148)

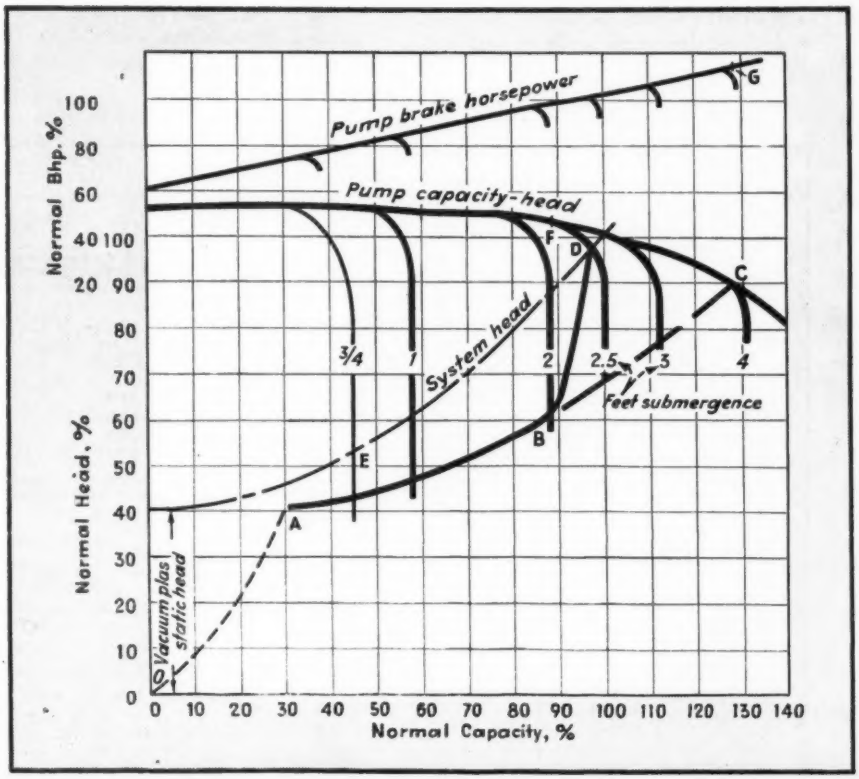


Fig. 3—Characteristic curves of constant-speed centrifugal condensate pump when operating with different submergence of its suction and with controlled discharge

Precision Testing for Dissolved O

Every passing year of operating experience with high-pressure boilers confirms the need for practically perfect deaeration of feedwater. J F Sebald, Worthington Pump and Machinery Corp, details test procedure for checking dissolved oxygen to an accuracy approaching one part in a billion

J F SEBALD

Five years of experimenting with field checking of deaerating apparatus has resulted in improved reliability of measurement for the several modifications of the basic method formulated by Dr L W Winkler. In this article Mr Sebald outlines the variations in method. Part II will detail precautions needed for testing and show degree of accuracy attainable. Part III will describe a typical analysis

► IN THE MANY YEARS since the Winkler test was first proposed, no other test for dissolved oxygen in water has been devised that has as broad a scope and is as universally applicable as that basic method. That this test is not suitable for accurate determinations of small quantities of dissolved oxygen and that it cannot be successfully applied to all types of water was recognized by Dr. Winkler.

As usually described in texts on quantitative analysis, the Winkler test is not applicable to checking performance of deaerators that reduce oxygen content to an extremely small percentage. The basic test is, however, sufficient for most oxygen-control analyses used to prescribe boiler-water treatment.

The tendency to replace the original Winkler test with some modification in an effort to eliminate or reduce some of the apparent limitations in the chemistry of the method has for the most part fallen short of the objective. Most of the refined procedures offer a real and definite improvement for accurately detecting small quantities of dissolved oxygen. Their failure to produce results considerably more reliable than those obtainable by the basic Winkler method can usually be attributed to poorly selected apparatus and inadequate test procedure.

Chemical reagents for the modified tests are generally the same as those for the basic Winkler test. The first of these, usually called *Reagent No. 1*, is a strong solution of manganous sulphate. *Reagent No. 2* is a strong solution of potassium hydroxide and potassium iodide. *Reagent No. 3* is a fairly strong solution of sulphuric acid.

By mixing these reagents in consecutive order in water containing dissolved oxygen, free iodine is liberated in direct proportion to the amount of dissolved oxygen present in the water. From a quantitative determination of the free iodine, the amount of dissolved oxygen in the original sample can be ascertained. Unfortunately, a certain amount of dissolved oxygen in each of the reagents is measured along with that originally in the water. An acceptable correction for the oxygen added with the reagents can, however, be applied to any of the Winkler tests or modifications if correction is required.

In addition, compounds may be

TABLE I—ANALYSIS OF VARIOUS

Procedure	*Winkler*			*Schwartz Gurney "A"*		
	Winkler sample X	Interference sample Y	Interference sample Z	Winkler sample X	Interference sample Y	Interference sample Z
1. Size of sample in cubic centimeters	500	.....	.....	500	500	.....
2. Quantity of reagents added, cc	3	.....	.....	3	3	.....
3. Order of adding reagents	1, 2, 3	.....	.....	1, 2, 3	2, 3, 1	.....
4. Quantity of iodine compound added, to establish titration level, cc	1	.....	.....	1	1	.....
5. Time of adding iodine compound, related to fixing	After	.....	.....	After	After	.....
6. Oxygen in water measured in sample	500A	.....	.....	500A	0	.....
7. Oxygen in reagents measured in sample	3B	.....	.....	3B	0	.....
8. Oxygen equivalent of interference measured in sample	500C	.....	.....	500C	500C	.....
9. Oxygen equivalent of iodine compound measured in sample	1D	.....	.....	1D	1D	.....
Definition of symbols	No interference samples so that $Y + Z = 0$			No Z interference sample so that $Z = 0$		
X = dissolved oxygen as measured by Winkler sample	$X = 500A + 3B + 500C + 1D$			$X - Y = 500A + 3B + 500C + 1D - 500C - 1D$		
Y = dissolved oxygen as measured by interference sample	Since 3B and 1D are known, they can be subtracted from the value obtained for the quantity of dissolved oxygen in the sample as expressed by X			$X - Y = 500A - 3B$		
Z = dissolved oxygen as measured by interference sample				Since 3B is known, it can be subtracted from the value obtained for the quantity of dissolved oxygen in the sample expressed by $X - Y$		
Note: Dissolved oxygen measured = $X - (Y + Z)$	Dissolved oxygen = $500A - 500C$			Dissolved oxygen = $500A$		
A = dissolved oxygen per unit volume of sample	Corrected Winkler sample indicates dissolved oxygen in the sample and the oxygen equivalent of interference in the sample. When no interfering compounds are present (C = O) the Winkler test is satisfactory			Corrected Schwartz Gurney "A" test indicates only dissolved oxygen in the Winkler sample either in the absence or presence of interfering compounds		
B = dissolved oxygen per unit volume of reagent						
C = dissolved oxygen equivalent of interference per unit volume of sample						
D = dissolved oxygen equivalent of iodine compound per unit volume of compound added to establish a level for electrometric titration (not needed for starch titration with basic Winkler test)						

Oxygen in Boiler Feedwater—I

present in the water to be tested which act the same as oxygen and are measured as dissolved oxygen by the test. Other compounds may also be present which may effectively prevent the test from showing the full amount of dissolved oxygen originally in the sample. These compounds, ordinarily present in boiler feedwater, are commonly referred to as *interference*. Those which act similarly to oxygen are called *positive* interference and those which act oppositely are termed *negative* interference. The basic Winkler test does not compensate for interference and its use in precision measurement is therefore limited. Modifications of the Winkler test, listed in Table I, compensate to a large degree for interfering compounds and, in some cases, eliminate the necessity for a separate reagent correction.

All five listed modifications of the basic Winkler test will correct to some degree for the presence of interfering compounds. None of these methods will correct for every type of interfering compound found in boiler feedwater although all will, in general, effect an improvement in the reliability of the test.

The tabulation in Table II is an example of the Schwartz Gurney "A" test in relation to interfering compounds in the water. Tests 1*A* and 1*B* were run under the same conditions and on the same equipment except for the nature of the water with respect to interfering compounds. The positive interference encountered in test 1*B* was principally from ferric oxide in the water. The tests' results are in close agreement and it would seem that the test method was suitable in this particular case. Tests 2*A* and 2 *B*, as well as 3*A* and 3*B*, were made under similar conditions and the results of all four of these tests should have been the same. Interfering compounds present in the water were primarily of an organic nature.

Results are in close agreement although it appears that there is a tendency for only partial interference correction. Such a conclusion should not be made, as the difference between the test readings is well within the accuracy of the test itself. No definite conclusion should be made from these results as they are not in sufficient quantity to

Table II—Effect of Interference Positive and Negative Schwartz Gurney "A" Test

Test number	*Interference as dissolved oxygen, cc per liter*	*Test result, dissolved oxygen, cc per liter*
1A	−0.0013	+0.0022
1B	+0.0970	+0.0019
2A	−0.0195	−0.0004
2B	−0.0072	+0.0004
3A	−0.0183	−0.0004
3B	−0.0079	+0.0005

Note: The first probable error of each test is approximately ±0.001 cc per liter expressed as dissolved oxygen.

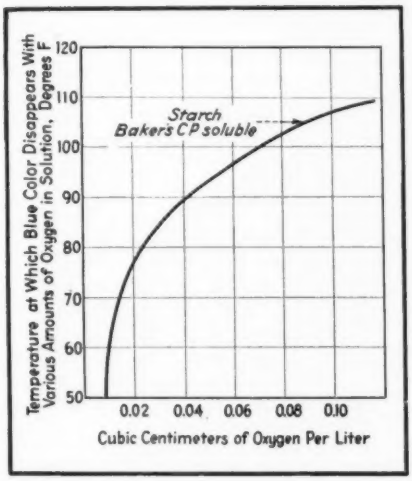


Fig. 1—Approximate amount of dissolved oxygen remaining in a sample at various temperatures for a typical root starch when the end point of titration is reached

MODIFICATIONS OF THE WINKLER TEST

Schwartz Gurney "B"			*U. S. Navy Lab—Schwartz Gurney "A"*			*Worthington—Schwartz Gurney "A + B"*			*Worthington—Schwartz Gurney "A + B" (with reagents of U. S. Navy Lab)*		
Winkler sample X	Interference sample Y	Interference sample Z	Winkler sample X	Interference sample Y	Interference sample Z	Winkler sample X	Interference sample Y	Interference sample Z	Winkler sample X	Interference sample Y	Interference sample Z
500	250	250	500	500	.....	500	250	250	500	250	250
3	3	.....	6	6	.....	3	3	3	6	6	6
1, 2, 3	1, 2, 3	.....	2, 1, 3	2, 3, 1	.....	1, 2, 3	1, 2, 3	2, 3, 1	2, 1, 3	2, 1, 3	2, 3, 1
1	1	.....	2	2	.....	1	1	.....	2	2	2
After	After	.....	During	During	.....	After	After	.....	During	During	During
500A	250A	.....	500A	0	.....	500A	250A	0	500A	250A	0
3B	3B	0	6B	0	.....	3B	3B	0	6B	6B	0
500C	250C	250C	500C	500C	.....	500C	250C	250C	500C	250C	250C
1D	1D	0	2D	2D	.....	1D	1D	0	2D	2D	2D
Interference samples Y and Z are combined and titrated together			No Z interference sample is taken so that Z = O			Interference samples Y and Z are combined and titrated together			Interference samples Y and Z are combined and titrated together		
X − (Y + Z) = 500A + 3B + 500C + 1D − (250A + 3B + 250C + 1D + 250C)			X − Y = 500A + 6B + 500C + 2D − 500C − 2D X − Y = 500A + 6B Since 6B is known, it can be subtracted from the value obtained for dissolved oxygen (X − Y)			X − (Y + Z) = 500A + 3B + 500C + 1D − (250A + 3B + 250C + 1D + 250C)			X − (Y + Z) = 500A + 6B + 500C + 2D − (250A + 6B + 250C + 2D + 250C + 2D) X − (Y + Z) = 250A − 2D Since 2D is known, it can be added to the value obtained for dissolved oxygen X − (Y + Z)		
Dissolved oxygen = 250A			Dissolved oxygen = 500A			Dissolved oxygen = 250A			Dissolved oxygen = 250A		
Indicates only dissolved oxygen in one half the full-size Winkler sample either in absence or presence of interfering compounds. The test corrects for dissolved oxygen added with the reagents			Corrected Navy test indicates only dissolved oxygen in the Winkler sample either in absence or presence of interfering compounds			Indicates only dissolved oxygen in one half the full-size Winkler sample either in absence or presence of interfering compounds. The test corrects for dissolved oxygen added with the reagents			Indicates only dissolved oxygen in one half the full size Winkler sample either in absence or presence of interfering compounds. The test corrects for dissolved oxygen added with the reagents		

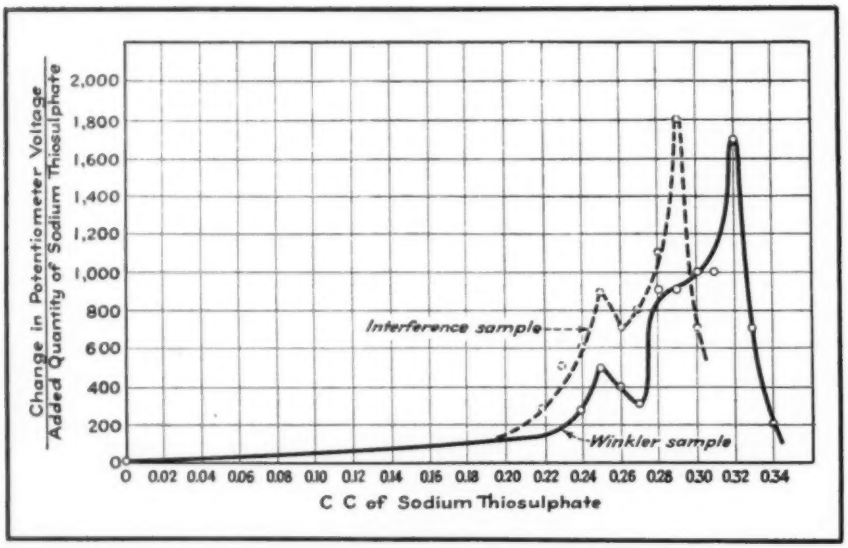


Fig. 2—Typical titration curve resulting from a plot of the ratio of change in potentiometer voltage to the quantity of thiosulphate added. Note sharp end point

Fig. 3—One type of electronic vacuum-tube voltmeter suitable for titrating oxygen samples. This type requires no adjustment or balancing during titration

establish a reliable proof. It is safe to infer that in most cases the interference correction will increase the reliability of the Winkler test and, therefore, with our present knowledge of the art, it should be used.

There is not sufficient data available at present to compare the relative effectiveness of these tests in correcting for interference. The selection of test method is largely a matter of personal preference.

It is usual practice to make a determination for dissolved oxygen by using starch as a color indicator and titrating until the blue color of the starch in iodine solution disappears or bleaches to white. The end point of the titration, the point at which blue color disappears, is not very definite. As a result, the use of this method for quantitative determination of dissolved oxygen is a common source of error.

Furthermore, the end point varies with the temperature of the solution titrated as well as with the type of starch used. Fig. 1 shows the approximate amount of dissolved oxygen remaining in the sample at various titration temperatures for a typical root starch. Knowing the titration temperature a correction can be made for the starch end point. Starches of the same grade frequently vary in sensitivity and the use of any correction curve is subject to some error. If starch titration is used in conducting those modifications of the Winkler test which incorporate interference samples, the use of the starch sensitivity curve is unnecessary, provided both Winkler and interference samples are titrated at about the same temperature with maximum temperature not exceeding 70 F.

Accuracy can be greatly increased by resorting to electrometric or potentiometric titration. The potentiometric end point of the oxidation - reduction titration is more definite than the end point designated by the color change in the starch indicator. The termination of the titration is easily recognized by a sudden change in voltage which occurs when the solution changes from oxidizing to reducing, or the reverse. By adding equal increments of sodium thiosulphate to the sample and observing voltage readings on a potentiometer, this point of sudden change in voltage can readily be ascertained. The actual electromotive force at end point varies with hydrogen-ion concentration (pH) of the solution.

Electrometric End Point

While it is possible to titrate to a fixed or known emf at the end point for any given value of pH such a procedure involves the determination of pH as well as the voltage at the end point. As pH varies with temperature, control of the titrating temperature as well may be involved. Perhaps the easiest way in which to determine the electrometric end point is to add starch to the sample which has an excess of free iodine in solution, either by the addition of known amounts of potassium bi-iodate or iodine, and titrate rapidly with rather large additions of sodium thiosulphate until the blue color approaches disappearance. Since there is a small amount of dissolved oxygen (iodine) present at the starch end point, the titration is continued by adding extremely small quantities of sodium thiosulphate in equal increments. By recording each sodium thiosulphate addition with the corresponding emf reading from the sample the end point of titration or maximum change in emf is readily discernable. Actual differ-

(*Continued on page* 186)

How to Figure Diesel MEP and HP From Indicator Diagrams

Taking indicator cards is just exercise unless you put the diagrams to work for you. Here are easy-to-follow methods for finding mean effective pressure and horsepower, and for plotting expansion lines

KEEPING DIESELS in the pink of condition starts with regular and careful use of a properly installed indicator, as covered in previous articles. But this is only a good beginning; taking cards wastes time and effort unless the operating staff knows how to put them to work spotting potential sources of engine trouble. This means being able to figure mean effective pressure and horsepower, to plot expansion and compression lines, and to recognize in the shape of diagrams the symptoms of faulty valve timing, injection misadjustments and combustion irregularities. What might be called the "figuring" part of the job is covered in this article; the troubleshooting angles will be treated later.

Finding mean effective pressure is a relatively simple operation. The indicator diagram is a closed figure, and its height at any point is proportional to the cylinder pressure at that point in the stroke, less the cylinder pressure at the same point in the compression stroke. In most 4-cycle engines the pressures on suction and exhaust strokes run nearly identical that the negative area between the two lines is neglected. If the height at any point represents effective pressure (expansion minus compression) then *mean* effective pressure is nothing more than the average height of the diagram. Now it can be seen that if we measure the diagram at a number of points and average the measurements, we get an approximation of mean effective pressure. To do it right, of course, we should divide the figure into equal parts and measure the height of each part. In Fig. 1, the indicator diagram is divided into ten equal sections along the length. Average height of each section may be represented by a vertical line at the center of the section, and the average of these vertical lines (l_1, l_2, l_3, etc) gives a close approximation of the average height of the entire diagram and thus of mean effective pressure. Dividing the diagram into ten parts permits figuring the average by inspection.

Simplified Method

Method in Fig. 2 simplifies dividing the diagram. Note in Fig. 1 that the vertical lines, on the basis of ten spaces, fall as follows: ½, 1½, 2½, etc to 9½. These points can be laid out directly, as in Fig. 2. Erect a vertical line at each end of the diagram, perpendicular to the baseline, *OX*. Place a rule in such a position that one end is at the diagram corner, *O*, and that some major division, say 5, is at the other vertical line. We thus have a total of five divisions and, as we want to divide the diagram into ten parts, each part will be one half of a division. The first point, being halfway of the first tenth part, is spotted at ¼ on the scale and the next point, being 1½ on the diagram, will be at the ¾ mark on the scale. Continuing as shown in Fig. 2 gives a fully divided diagram.

The points, at which the resulting vertical lines cut upper and lower lines of the diagram, mark the limits of heights l_1, l_2, l_3, . . . l_{10}. These can be measured and added; some engineers prefer to transfer the distances consecutively to a strip of paper and measure the total distance in one operation. Dividing the sum, however found, by the number of lines, ten in this case, gives average diagram height in inches. This is proportional to mean effective pressure, the factor being the spring scale. If the average height proves to be 0.35 in. and the spring scale is 200 psi per in., mean effective pressure is 70 psi.

Use of a *planimeter* offers the quickest and most accurate means of deter-

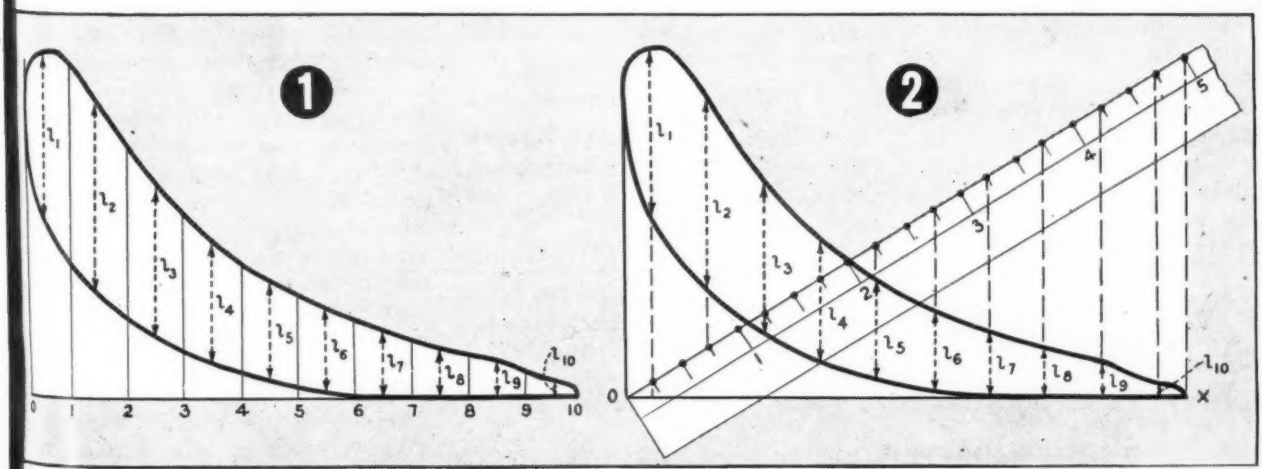


Fig. 1—Mean height of diagram is found by dividing into equal parts and averaging measured heights. Fig. 2—This procedure simplifies dividing volume line into equal parts. For convenience, number of parts is usually taken as ten.

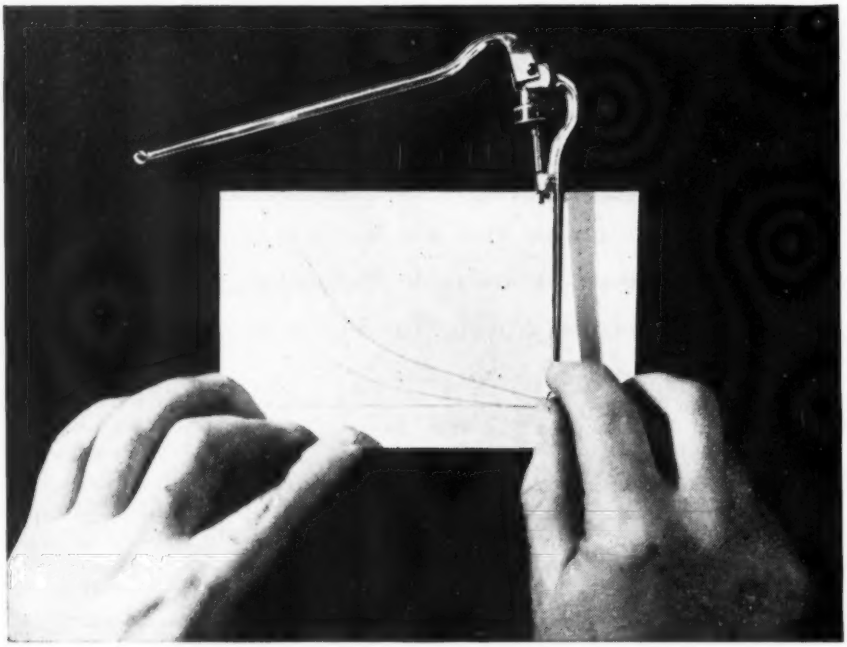


Fig. 3—A planimeter measures card area directly. From this, horsepower and mean effective pressure can be found simply, by allowing for scale factors

mining mean effective pressure. Set the wheel at zero and trace the diagram outline carefully, as in Fig. 3. Read the vernier scale as you would any other vernier. This gives the diagram area in square inches and dividing by the length of the diagram in inches gives the average height in inches. Multiplying by the spring scale yields mean effective pressure, in psi.

Determination of mean effective pressure is valuable in itself, as a check on engine performance. Most engines are rated at a certain mean effective pressure, which may range from 60 psi to as much as 150 psi for high-speed high-output engines. Note that mean effective pressure determined from an indicator diagram, by methods outlined above, is known as *indicated mean effective pressure* or *mean effective pressure referred to indicated horsepower*. The difference between this mean effective pressure and so-called *brake mean effective pressure* will be discussed later.

Knowing mean effective pressure, it is possible, by using a familiar formula, to figure horsepower. The formula is

$$HP = \frac{PLAN}{33{,}000}$$

where P = mean effective pressure, psi
L = piston stroke, ft
A = piston area, sq in.
N = number of power strokes per min, (one-half rpm for 4-cycle engines and rpm for 2-cycle)

Since for any particular engine, the stroke and piston area are fixed and speed is usually fixed, the formula may be reduced to

$$HP = P \times \text{a constant}$$

For example, assume a 10x12-in. 4-cycle 400-rpm engine. To find the constant, we substitute in

$$\frac{LAN}{33{,}000} = \textit{constant}$$

For this engine, piston stroke L is 12 in., or 1 ft, and piston area equals diameter squared times 0.7854, or 10x10x0.7854= 78.5 sq in. For a 4-cycle engine, N is one half the rpm or, here, 200. The constant then is

$$\frac{1 \times 78.5 \times 200}{33{,}000} = 0.476$$

This means that the horsepower developed in one cylinder of this engine is 0.476 times the mean effective pressure as determined from indicator cards.

Horsepower figured in this manner is *indicated horsepower*. It is the horsepower actually developed in the cylinder. However, part of this cylinder output is consumed in friction and does not appear as useful power at the engine shaft. Actual shaft output is called *brake horsepower* because a *prony brake* is often used to measure it. Ratio of the shaft output, or brake horsepower, to indicated horsepower is the *mechanical efficiency* of the engine.

Finding Brake Horsepower

Lacking test equipment, the average operator must find brake horsepower indirectly. This can be done, with reasonable accuracy, by taking indicator cards at no load as well as at full load. No-load cards indicate the power that goes into overcoming friction and when this horsepower is subtracted from the full-load indicated horsepower, the result is brake horsepower. Although the assumption is not strictly accurate, *friction horsepower* may be taken as the same at all loads, so subtracting no-load horsepower from indicated horsepower at any load gives brake horsepower at partial load. Of course, if the engine drives a generator, and if accurate electrical meters are available, the generator output can be measured and from this the engine output can be figured by making due allowance for known generator losses. The result is brake horsepower.

When brake horsepower of an engine is known, the formula used before to find indicated horsepower can be turned around and used to find *brake mean effective pressure* or *mean effective pres-*

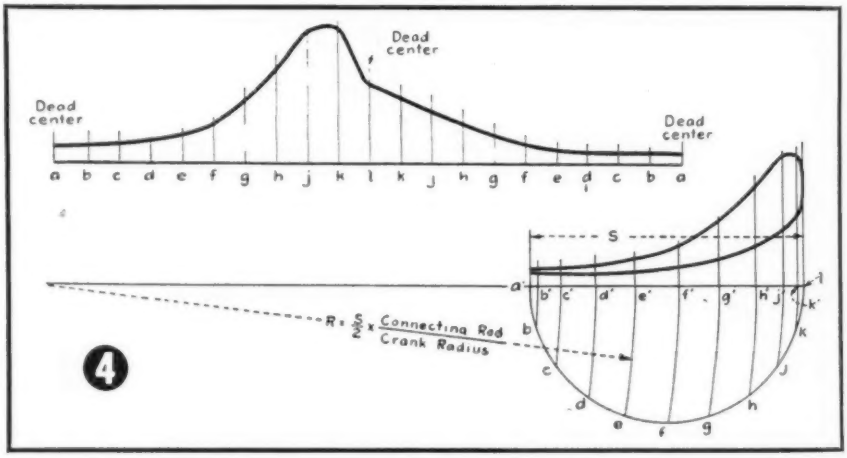

Dead center
Dead center
Dead center
a b c d e f g h j k l k j h g f e d c b a
S
$R = \frac{S}{2} \times \frac{\text{Connecting Rod}}{\text{Crank Radius}}$
4

Fig. 4—A pressure-time diagram drawn by an indicator with a chronomatic drum can be converted into a pressure-volume diagram by replotting as shown

sure referred to brake horsepower. The modified formula is

$$BMEP = \frac{BHP \times 33{,}000}{ALN}$$

where *A*, *L* and *N* are the same as before, *BHP* is brake horsepower and *BMEP* is brake mean effective pressure.

Thus far we have dealt entirely with the pressure-volume indicator card. Pressure-time cards made on indicators fitted with a drum that can be rotated at a predetermined speed will yield data on mean effective pressure and indicated horsepower. Actually, the method involves converting the pressure-time diagram into a pressure-volume diagram, as in Fig. 4. Start by drawing a baseline, *S*, for the pressure-volume diagram, which can be of any convenient length although generally taken as about half the length of the pressure-time diagram. Then erect on the baseline, *S*, a circle, representing the crank circle. Divide the baseline of the pressure-time diagram, from bottom dead center to top dead center, into a number of equal parts and divide the crank circle into the same number of equal parts.

Next figure the ratio of the engine's connecting rod to its crank radius and multiply this number by one half the baseline distance, *S*. This gives the radius of a series of arcs to be used to transfer the crank circle divisions to the baseline, *S*. Expressed as a formula, the radius is

$$R = \frac{S}{2} \times \frac{\text{connecting rod}}{\text{crank radius}}$$

all lengths being expressed in inches.

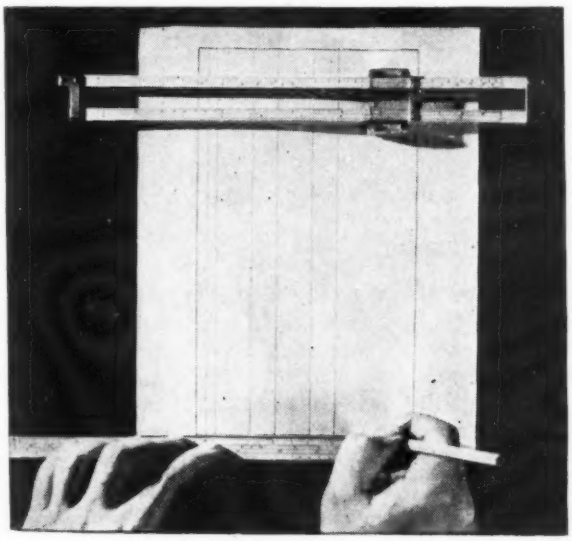
Plotting P-V Diagram

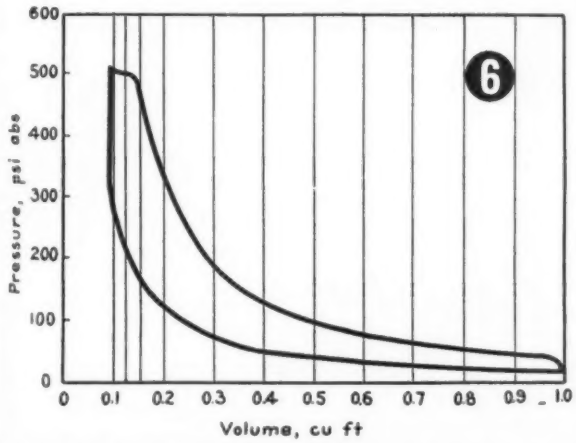
Using this calculated radius, draw an arc from each crank-circle point to the baseline *S*. At each point of intersection, erect a perpendicular, as in Fig. 4. Then transfer to these perpendiculars the height of the expansion and compression curves, as measured on the pressure-time diagram. The result is a pressure-volume diagram, which can be planimetered, or otherwise measured, to determine mean effective pressure and horsepower.

One additional trick of indicator-card analysis should be in the operator's tool kit—use of logarithmic plotting to check the expansion line and to detect afterburning. Basis of this method can be reduced to fairly simple terms. For a diesel expansion curve the formula is such that when plotted on logarithmic paper it is a straight line.

To make the transformation, secure plotting paper with a logarithmic scale both ways. If it is not readily available, a satisfactory substitute for the manufactured product may be made by using the logarithmic scale of a slide rule, as in Fig. 5. Lay out the scale horizontally first, beginning at 0.08, or whatever value best suits the cylinder volume of the engine. The succeeding points, 0.09, 0.10, 0.15, 0.20, etc, are transferred to the paper in a similar manner.

(*Continued on page* 184)





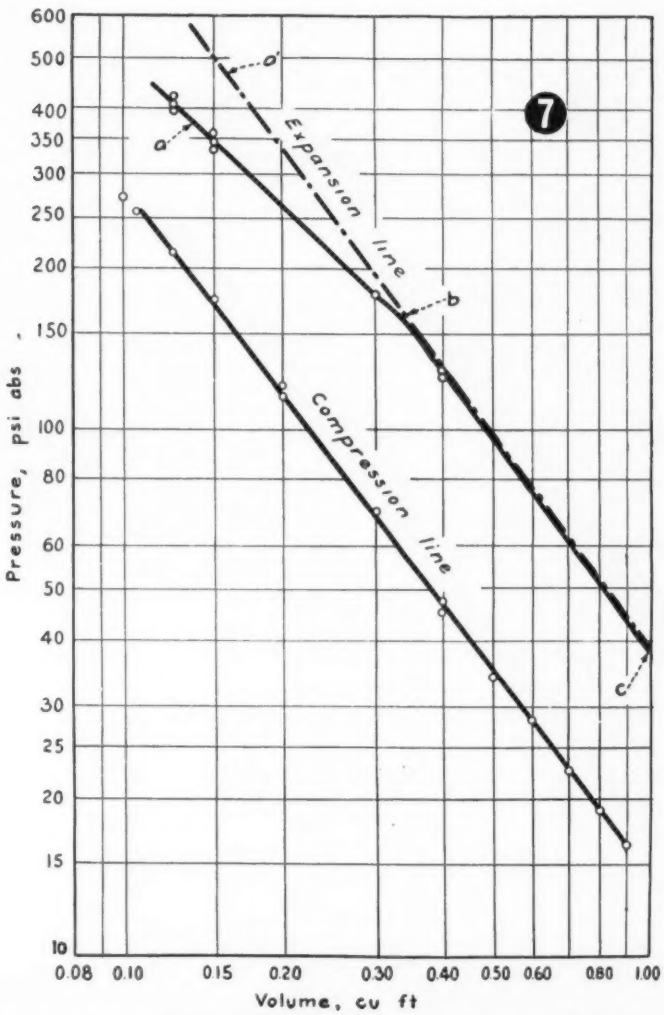


Fig. 5 (photo above)—Logarithmic paper for plotting expansion and compression lines can be made by transferring scales from a slide rule. Fig. 6—Before plotting, card must be divided, allowing for clearance volume. Fig. 7—Compression and expansion lines plotted on logarithmic paper; lines should be essentially straight as *a'c*; shape of *abc* shows afterburning

Chile Builds an Industrial Future on a 3-Million-Kw Power Program

Nationwide 18-year program will provide power for expanded steel, copper and cement industries and for electrification of railroads, mines and farmlands

By HOWARD E WAY, *Industry Analyst, Bureau of Foreign and Domestic Commerce*

CHILE'S 18-YEAR HYDROELECTRIC PROGRAM IN BRIEF

Zone	Geographical Area	Potential Kw	At End of 18-yr Program		End of 1945 Total Kw
			No. of Plants	Total Kw	
1	From Arica on extreme northern border to Vallenar	103,300	13	73,300	3,450
2	From La Serena to Las Vilos	164,600	15	106,400	32,070
3	From Petorca to Linares	1,963,350	51	1,448,750	210,000
4	From San Carlos to Traiguen	837,900	14	496,900	55,500
5	From Lautaro to Puerto Montt	2,969,100	23	1,653,000	70,340
6	From Puerto Aysen to Isthmus of Ofgui	Undetermined	...	.....	.....
7	From Isthmus to Straits of Magellan	Undetermined	...	.....	.....
	Total	6,038,250	116	3,778,350	371,360

► CHILE, with the unusually large per capita electric-power potential of 520 watts, plans to capitalize this asset as part of its long-range program for national industrialization. As announced recently by the *Corporacion de Fomento* (National Development Corp), the power program requires an estimated 18 years and may cost several hundred million dollars. A special corporation, *Empresa Nacional de Electricidad*, has been set up to supervise the power development and make it a reality.

Seldom more than 100 miles wide for all its 2600-mile length, Chile is ideally endowed as a producer of hydroelectric power. The Andes, which form the backbone of this republic, rise to peaks over 20,000 ft and numerous rivers fed by snows and glaciers dash down the mountain slopes to the sea. On the other hand. Chile's known coal reserves amount to only 300 tons per inhabitant, against 22,300 tons per inhabitant in the United States and the world average of 2500 tons. Thus Chile's 18-year program envisions extensive electrification of railroads, industrial establishments, mines and smelters and, through rural cooperative societies, encouragement of the use of electricity in agriculture.

The 18-year program calls for creation of hydroelectric stations in seven areas of the republic, from which will extend a network of distribution lines and substations, while interconnecting power lines will tie the entire nation into one coordinated power system. This will be in addition to the generation facilities and transmission system built up by private enterprise.

The table above and the map on the facing page show the seven zones or geographic areas and the potentials of each. Development of this huge power reserve must necessarily spread over many years. The program for the first 6-year period, already under way, calls for plants at Puclaro, Sotaquia, Gogoti and Guayacan in the second zone; at Sauzal, Rapel, Tumunan, Colbun and Queri in the third zone and at Manio, Colico, Pilmaiquen, Lago Chapo and Ralun in the fifth zone. Construction of a 13,340-kw plant at Pilmaiquen on the river of the same name comes first, followed by a 55,500-kw plant at Abanico on the Laja River, a 72,000-kw unit at Sauzal on the Cachapoal River, and the Puclaro plant near Coquimbo.

According to present estimates, nearly $18,000,000 will be spent in the United States for equipment by 1945, with expenditures of over $21,000,000 in Chile. Financial assistance is being extended by the Export-Import Bank of Washington, D. C.

Side by side with provision of generating and transmission facilities must go development of consumption. As one step, ENE (Empresa Nacional de Electricidad) plans to take an active part in aiding small industries, municipalities and farmer cooperatives in making the most of the electric power at their command by distributing motors, machines and irrigation pumps on long-term, low-interest credits. It is also planned to develop by irrigation the hundreds of miles of arid plains which now sweep north from La Serena to the Peruvian border.

Power from the Aconcuaga River system will go largely to the Portland cement industry, saving the cost of shipping coal from the mines in the south. At present accelerated rates of

production, estimates indicate Chilean industries will consume 600,000 tons of cement per year by 1945, or nearly double 1939's production. By 1957, an estimated $100,000,000 will have been invested in this program.

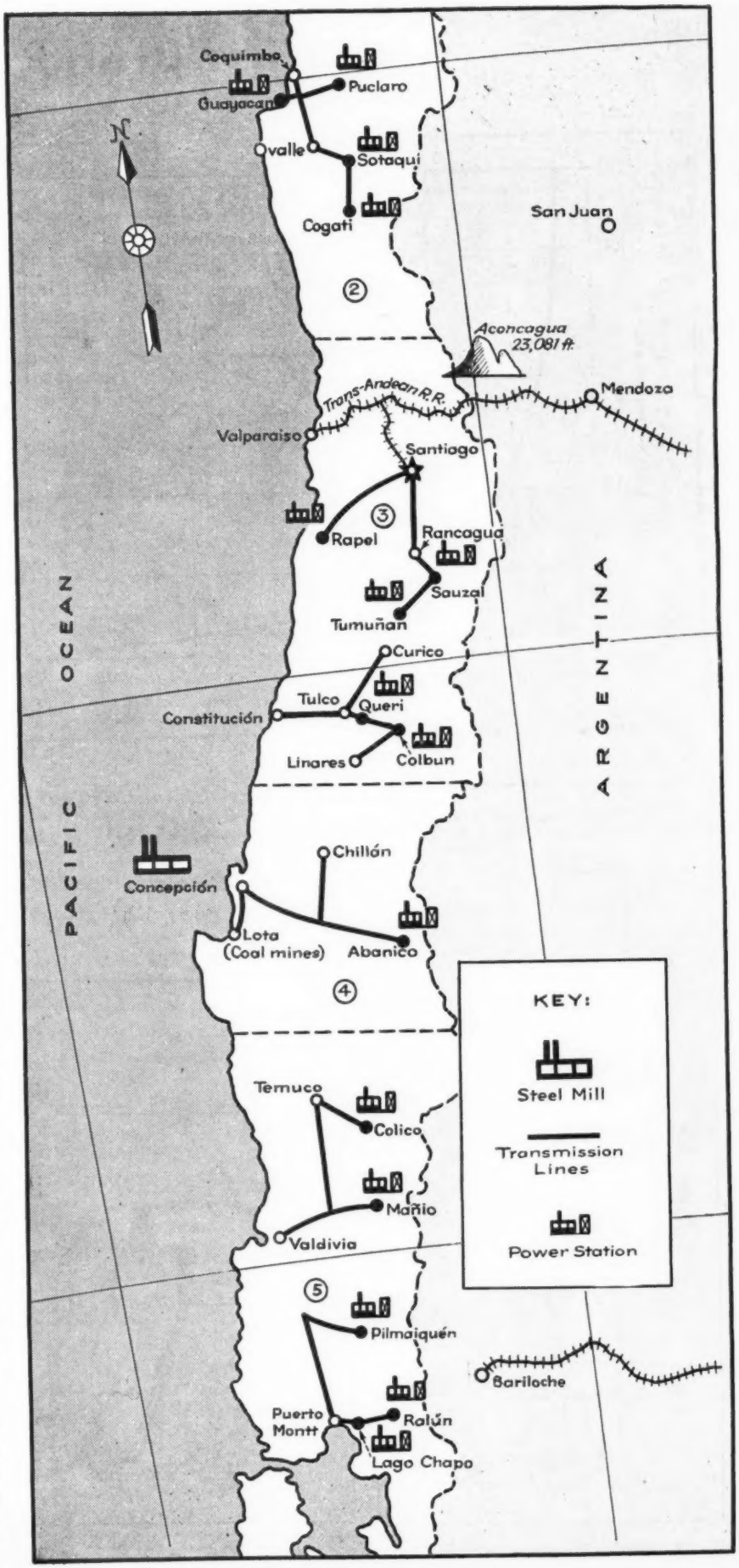
Chile, according to Julio Ibanez, well-known Chilean engineer, consumes 130,000 tons of rolled steel annually and produces 45,000 tons. It is desired not only to supply the present demand fully but also to increase domestic uses for industrialization and ship construction and to be able to export steel. Chile plans to install smelters, steel mills and copper-working plants, all to be operated by electricity, and to fabricate for its own use the copper and iron found within the republic.

New Steel Mill Planned

One new steel plant, in the Concepcion region, will produce 120,000 tons per year. Present plans call for this plant to be in operation late in 1945 or early in 1946. Equipment will be installed to roll reinforcing steel, light structural shapes, thin plates and sheets, strip for welded pipe, and to draw wire. Electric furnaces, supplied with power from the Abanico plant, will smelt the high-quality ore from the El Tofo region of northern Chile, which has long been exported. These two furnaces, of the Swedish Tysland-Hole type, will each have a capacity of 120 tons. Other equipment will include a bessemer converter, electric steel furnaces, a mixer and byproduct coke ovens. The abundance of cheap hydro power and the fact that Chilean coal is not suitable for metallurgical purposes makes it economical to use electric smelting.

Plant for making copper wire, shipped from the United States to Chile last spring, will soon go into production, it is stated, and will have a capacity of 30,000 tons of finished copper wire and other products each year. This material will play an important part in electrification of the Chilean State Railways from Santiago to Concepcion (see map).

Another electrification project concerns Chile's main coal mines at Lota. These are extremely deep—more than 1300 ft—and extend westward for three miles out under the sea on a front of nearly five miles. It takes a lot of power to bring this coal to the surface and load it into cars or vessels for transportation. Estimates indicate that these operations consume nearly one-tenth of all coal mined. By supplying these mines with hydro power from nearby stations, coal reserves will be saved and made available for various essential purposes.



Hard-Working Boilers Demand R

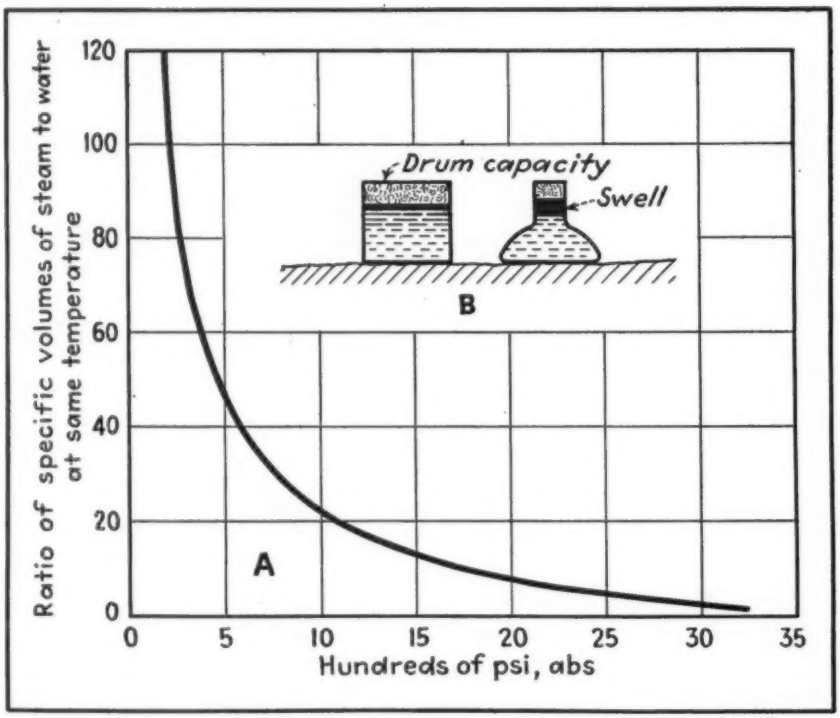


Fig. 1, *left*—(A) Swell becomes less at higher pressures as steam and water volumes are nearly equal. (B) Drum capacity of hrt compared to modern boiler

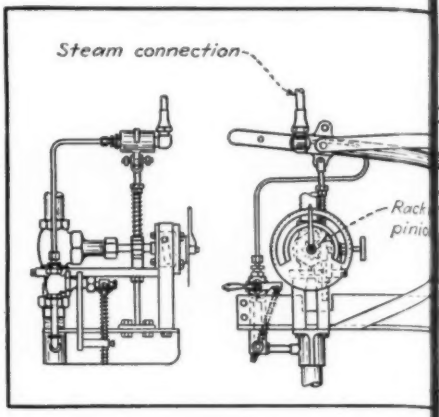


Fig. 2—Thermostatic tube regulator fitted with cooling fins on its water end; this

The ideal automatic regulator is simple, rugged and reliable. It must correctly adjust the feed with least possible time lag. Here are nine devices that can do the job and the reasons why they work for safer, more efficient steam generation

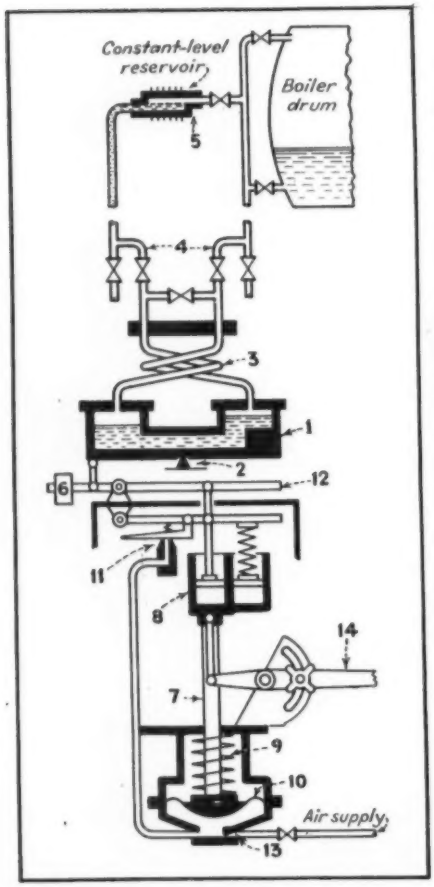


Fig. 4—Change in water level unbalances mercury in U-tube and tilts it

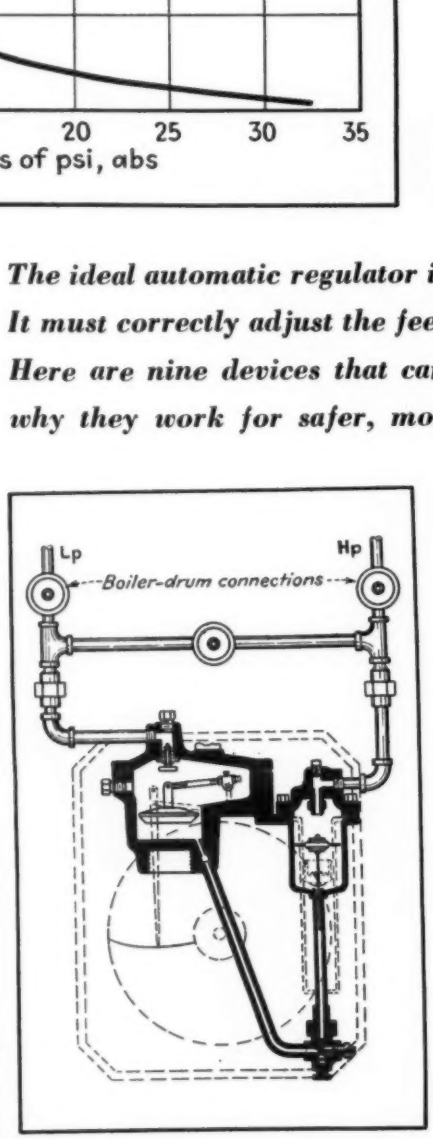


Fig. 5—Float riding on the mercury transmits motion to a controller

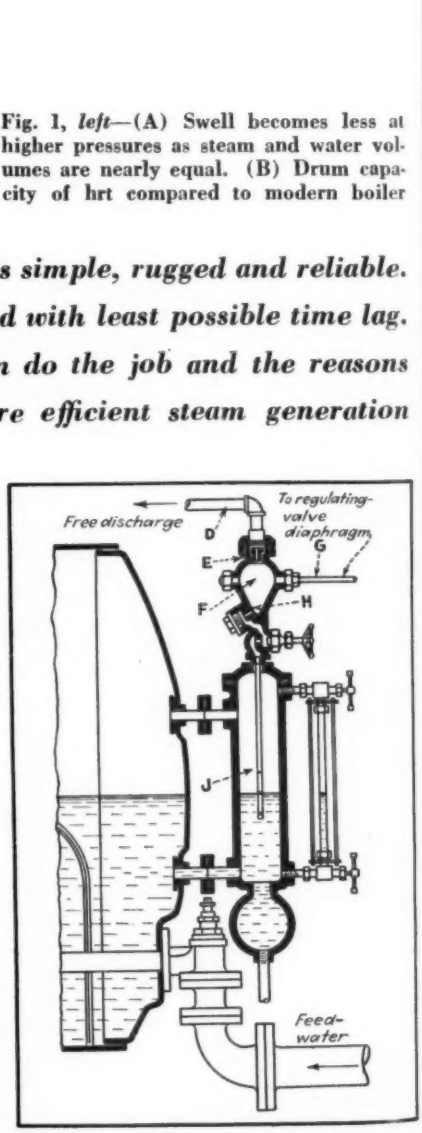
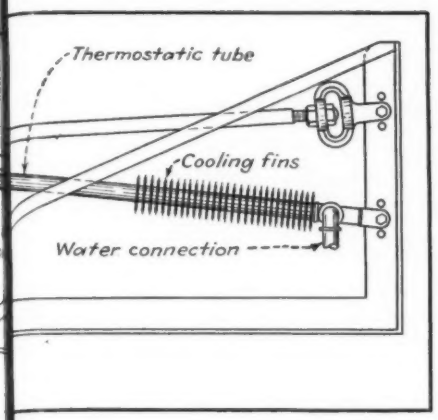


Fig. 6—Quality of mixture entering chamber *F* determines the pressure at *G*

Responsive Feedwater Control



unit operates a screw-stem regulating valve through a rack and pinion

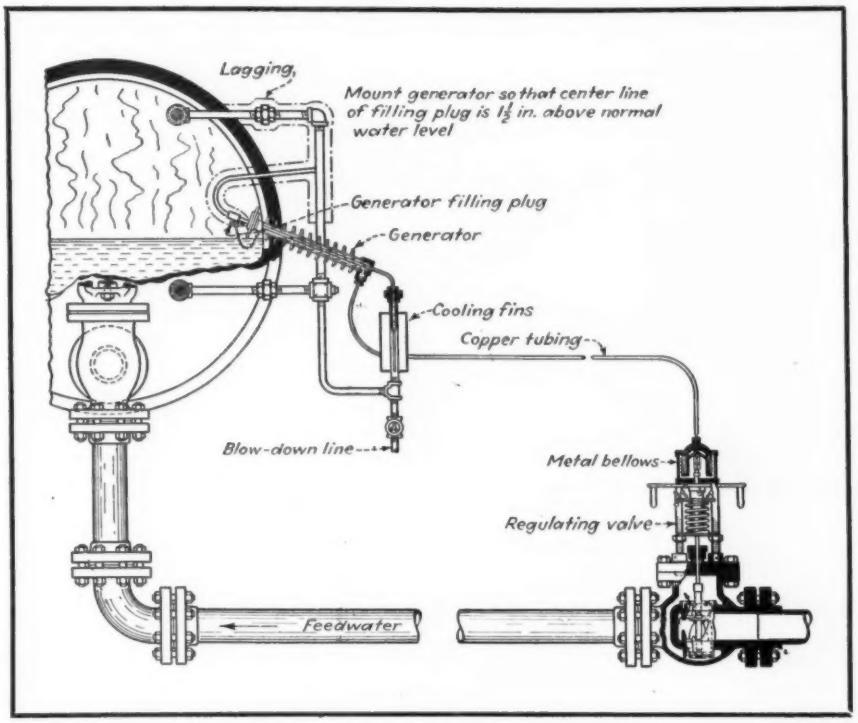


Fig. 3, *right*—A heater tube connected to drum generates steam in encircling tube to operate a regulating valve. Water level determines pressure generated

▶ IN ONLY A FEW YEARS steam-generator changes have been so extensive as to demand fuel, air and water control that is highly accurate. Today, heating surface consists largely of waterwalls, economizers, superheaters and reheaters, with reduced water-storage capacity in the drum. Thus, water circulates more rapidly and steaming capacity is greater.

Important to efficient steam generation and operating safety is automatic feedwater regulation. To better understand it, let's first see how water acts inside boiler shell or tubes. When a boiler produces steam the circulating water's density is reduced both by its heat and the vapor bubbles entrained in it. Therefore, as steaming rate rises a fixed weight of water has increasing volume, or swell, which may amount to more than 20% at maximum rating, with a corresponding rise of many inches in water level. Factors that influence swell are: (1) drum pressure, (2) ratio of water in drum to total water, (3) ratio of heating surface to water volume, (4) liberating area at water level, (5) rate and temperature of feed supply, and (6) concentration of solids:

Drum pressure: Swell is more important at relatively low pressures than at higher because one pound of low-pressure steam occupies a much greater volume than one pound of water at the same temperature, Fig. 1*A*. At the critical pressure of steam (3226 psi abs) its specific volume is the same as that of water, so the swell is zero.

Ratio of water in drum to total water: Boilers that have large heat absorption area in steaming tubes and waterwalls, with relatively small drum storage, are more affected by swell (similar to a bottleneck) than the usual firetube unit, Fig. 1*B*. At full rating, such a boiler may empty its drum quickly if feedwater flow stops.

Ratio of heating surface to water volume: Sudden wide fluctuation in steaming rate may cause considerable change in water level, making it desirable to carry a relatively low water level in the drum at low rating so that sudden load increase does not cause carryover. Conversely, at high rating it may be desirable to carry the water high enough so that a sharp load reduction will not drop the water out of sight or expose the tubes.

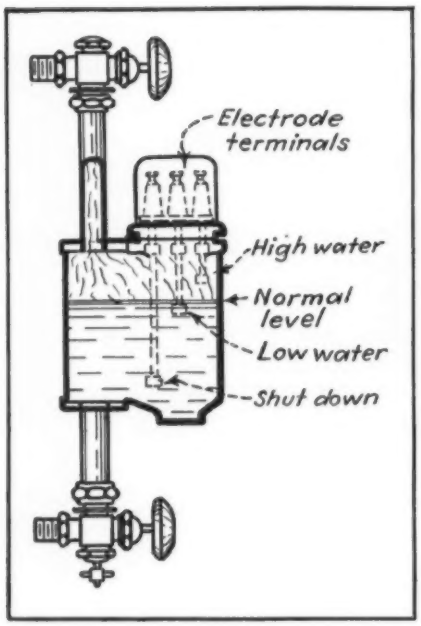
Liberating area at water level: High steaming rates raise the water higher than low rates. Also, a sudden increase in load that reduces the drum pressure slightly lowers the water's boiling point so that it boils faster, and the level rises. Conversely, a sharp reduction in load increases the pressure and depresses the water level.

Rate and temperature of feed supply: Unless feedwater is as hot as that in the drum it will cool the boiler water and reduce its swell. Also, the rate at which the water enters reduces swell to greater or less degree, depending on the quantity of water flowing.

Concentration of solids: Heavy concentration of solids and impurities causes a boiler to foam, which may raise the water level high enough to prime or carry over into the steam header.

Boiler water level is always higher than that shown by the gage glass. The glass is merely one leg of a U-tube, while the boiler itself is the other leg. U-tube levels balance as far as unit weight of the two legs is concerned, but their relative height depends on their relative density. For instance, suppose you half fill a U-tube with water and then pour a lighter liquid into one side. Difference in the height of the two columns is considerable, and it increases with increase in tube length.

Since the gage glass contains water free of steam bubbles at a temperature considerably lower than that in the



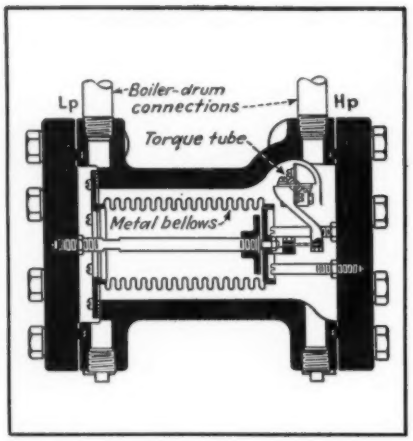


Fig. 8, *above*—Movable bellows transmits movement through torque-tube seal

Fig. 7, *left*—As water level changes, it makes or breaks an electric circuit

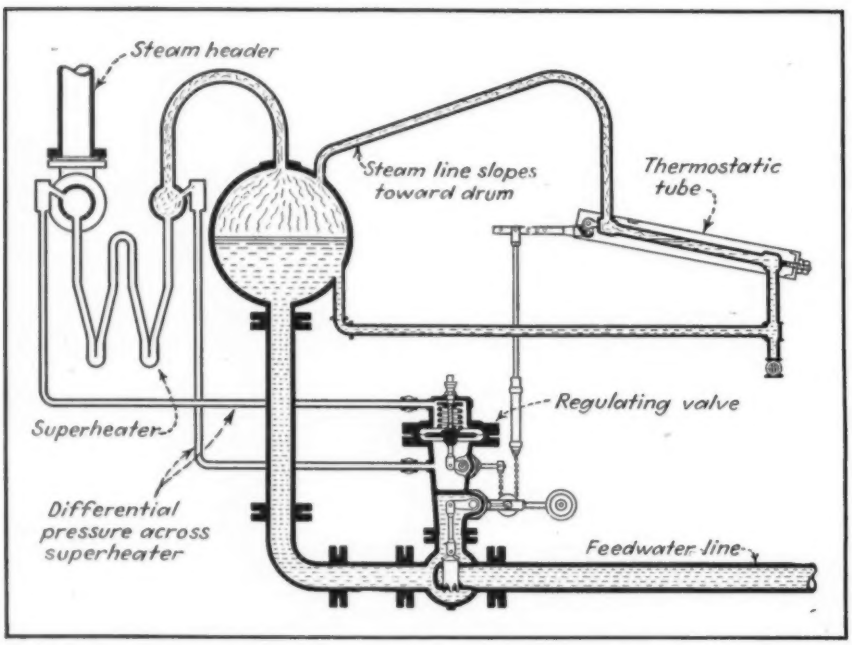


Fig. 9—This 2-element steam-flow regulator measures pressure drop across the superheater. Differential pressure acts on diaphragm to adjust valve setting

boiler, this water is heavier and can balance a higher column of water in the drum. Should the glass connect directly to the drum, there would be no appreciable density difference because gage-water temperature would be practically the same as that in the boiler.

Consider an hrt boiler with a water connection to its gage glass 30 in. below normal water level. Water column is piped out several inches away from the boiler where its temperature is about 70 F lower than that of the boiler water. Water's coefficient of expansion within this range is approximately 0.000643. Multiplying this by 70 (number of degrees difference) then by 30 (water-connection length) equals 1.35 in. Allowing 10% for steam bubbles gives 3 in.; 3+1.35 equals 4.35 in.—difference between boiler and gage-glass level. Another discrepancy in gage-glass indication comes from uneven circulation in watertube-boiler downcomers that leave opposite ends of the drum. A glass installed on one end of the drum does not give a true picture of level conditions across it.

Any action inside the boiler that causes untrue gage-glass indications also affects an automatic feedwater regulator the same way. For instance, if gage glass shows half full and boiler-water level is actually several inches higher causing moisture carryover, an automatic regulator adjusted to operate at this point permits the boiler to discharge wet steam continuously. The regulator feeds enough water to maintain the level for which it is set, but it has no way of determining whether this setting is too high or too low.

Regulators that are simple, rugged and reliable, and that are capable of correctly adjusting the feed with least possible time lag are: (1) thermostatic, (2) steam-generator, (3) tilting-mercury-chamber, (4) mercury-manometer, (5) varying-pressure-chamber, (6) immersion-electrode, (7) aneroid manometer, and (8) float-mechanism.

Thermostatic-inclined tube, Fig. 2, usually of brass, or other alloy, with a high coefficient of expansion, mounts alongside the boiler so that the water level cuts across it near the center of its working range. Force made available by the metal's expansion is limited only by its elastic limit. Tube's lower end is anchored and connects by piping to the boiler below its water level; upper end is free to move and connects through flexible piping to the boiler steam space.

When the boiler-water level changes, the tube-water level moves the same vertical distance; but lengthwise change in the tube level depends on tube slope. This water does not circulate; therefore, it cools off by radiating heat to the atmosphere. Some tubes carry radiating fins on their water end to accelerate cooling.

Since the tube's steam end is always hot, any change in water level either reduces or increases the surface contacted by hot steam, thereby expanding or contracting the tube. To complete the regulator the tube's free end has to connect through suitable linkage to a relay, or regulating valve in the feedwater line.

One design, Fig. 2, multiplies expansion by pivoting the tube's lower end to a vertical frame member which carries a pivoted rigid bar that connects to the tube's free end. Pivoting points are 7 in. apart, which produces a rigid triangle. As the ratio of the length of the long sides to the short is 6 to 1, a change in tube length raises or lowers the tube end approximately 6 times the amount of that change.

Steam-generator regulator, Fig. 3, consists essentially of two tubes, an outer one, which is fitted with cooling fins, and an inner one, which serves only as a heating element, connecting

TECHNICAL EDITOR WANTED

To build its staff for greater service, also to insure against the possible loss of an Associate Editor to the armed services, POWER takes this unprecedented step—comes to its readers for help on a manpower problem.

Here's the story in brief: We will add an Assistant Editor to the POWER staff as soon as we can find the right man. And that man, in all probability, is already a regular reader of these pages, so this is the place to look for him.

This potential editor is likely to be a graduate mechanical or electrical engineer, but may happen to be self-educated on the job. In either case, he is intimately and practically familiar with steam plants (either industrial or utility) and probably has a good understanding of one or more of the following power specialties: electricity, heating, refrigeration, mechanical power transmission, pumping, instruments, fuels, etc. He is intensely practical, and a straight thinker. He has some ability to write on everyday engineering matters in clear straightforward language. He has not necessarily ever been in an editorial office, but he has written an article or a letter to the editor, or has done enough other writing to indicate that he can learn to prepare and edit technical articles.

Any reader who thinks he fits this picture is invited to write a letter to the editor, Philip Swain, outlining his personal and technical history and telling why he thinks he could handle this job.

For the right man, this looks like a permanent connection—hard but intensely interesting work with a good future. And despite wartime problems, POWER will be fussy about quality of its manpower, as always.

PHILIP W. SWAIN,
Editor

to a boiler drum above and below the water level. Inner tube then contains steam and water, the water level being the same as that in the boiler drum. Annular space between inner and outer generator tubes forms a closed system with the connecting copper tubing and metal bellows of the regulating valve.

Volumes in the closed system are so proportioned that when the regulating valve is wide open, steam completely fills the annular space in the generator and when the valve is closed water fills this space. Normally these extremes are not reached and a continuous feed is delivered with the water level near the center of both inner and outer tubes.

The generator shell has two openings, one at the bottom that connects to copper tubing leading to the regulating valve, and the other at the top for filling the system with water. This opening is placed on the side of expansion head to prevent overfilling the generator.

Water leg from the boiler carries radiating fins to insure a supply of relatively cool water at the bottom of inner generator tube. When boiler-water level rises, this cool water passes up into the tube and helps condense the steam in annular space of outer tube.

Tilting-mercury-chamber unit, Fig. 4, consists of a large cast-iron and steel U-tube (1) containing 12 lb of mercury and delicately balanced on a fulcrum (2). Each side of the U-tube connects to boiler drum through torsion tubes (3) and piping (4).

Steam condensed in the constant-level tank (5) maintains a constant head of water on the left-hand side of mercury differential element. Right-hand pipe goes to bottom of boiler drum, putting the mercury in this side of U-tube under a varying head of water. Setting of weight (6) determines the drum level which the regulator will maintain. When water level changes mercury flow unbalances the chamber so that it tilts on the fulcrum.

Mercury-differential element connects to an amplifier piston rod (7) through a stabilizing dashpot (8). Spring (9) tends to move piston rod (7) downward

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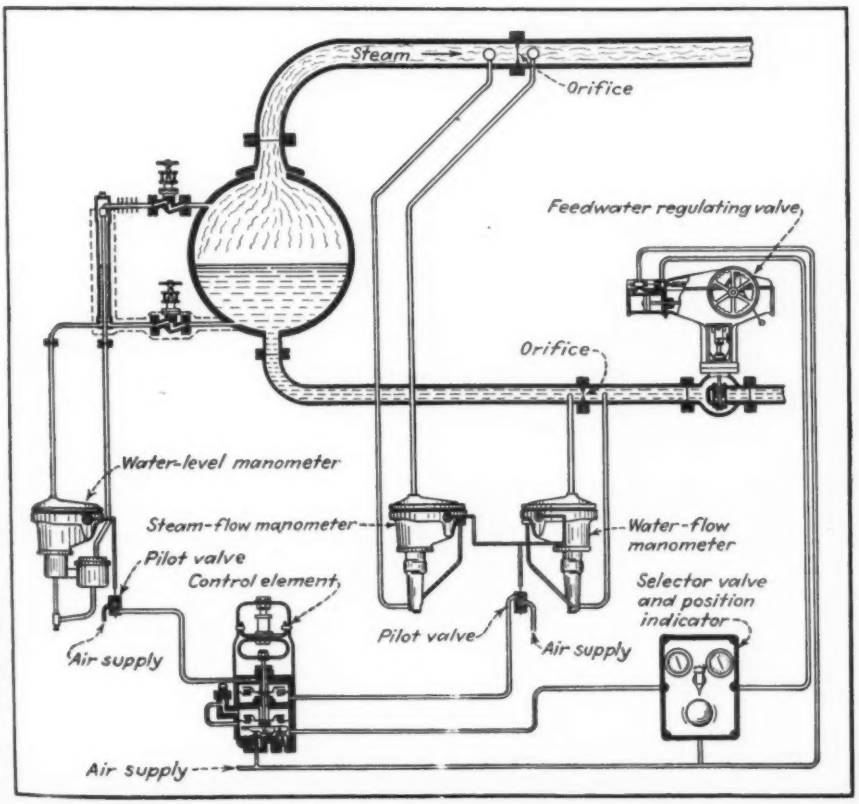

Fig. 10—**This 3-element unit measures the drop across orifices in steam and water lines. Each element operates a pilot valve in the air supply to controller**

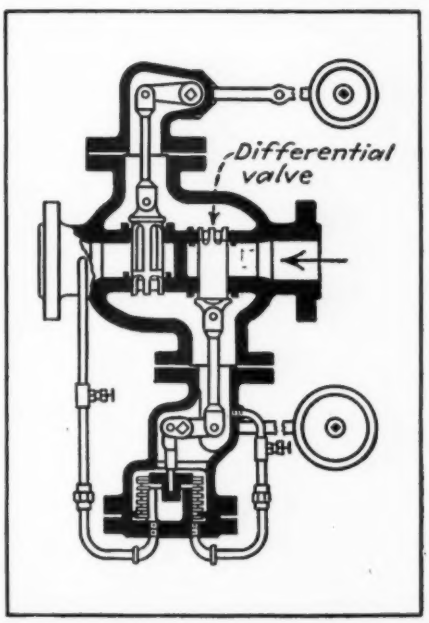

Fig. 11—Holding constant pressure drop across main valve improves regulation

Producer Gas—Future

The need to find a way to burn coal, directly or indirectly, in combustion-gas turbines, redirects attention to completely gasified coal in form of producer gas or blue-water gas

► EARLY IN THE TWENTIETH CENTURY the producer-gas-fueled engine won the favorable attention of many power engineers, then faded into obscurity for various practical reasons. Today, in the United States, the gas producer is rarely a power unit, although it serves many industrial processes.

Meanwhile technology moves ahead, and we view old devices from a new angle. Thus the rapidly developing gas turbine looks for a way to burn coal, America's basic fuel, and sees a possible ready-made answer in the gas producer—a simple device, and the most efficient known method of converting coal into fuel gas.

In recent POWER articles S A Tucker and others have discussed the theory, present accomplishments and probable future of the gas turbine.

So far the applications have been mainly to the Houdry process of oil refining. One complete gas-turbine electric power unit has been built and tested in Switzerland (POWER, Feb, 1940). The outlook is favorable for driving blast-furnace blowers by turbines fired with blast-furnace gas. This is now commercial in Europe, and America may soon install such units. A quasi-experimental gas turbine is now on order for an American merchant ship.

Coal Is Basic Power Fuel

Within a few years we may reasonably expect to see gas-turbine locomotives (one is already operating in Switzerland), gas-turbine drives for booster compressors and pumps of gas and oil pipelines, and a few gas-turbine central power stations in localities where oil and natural gas are cheap, or where cooling water is lacking, or where low-cost standby plants are required.

While engineering refinements, more complex cycles, and better materials to permit higher inlet gas temperatures will steadily expand the gas turbine's economic field, this unit will not generally compete on even terms with the steam turbine as a central-station prime mover until it can burn coal. Coal has long been the basic fuel for power generation in stationary plants, and its economic advantage over other natural fuels will increase with the years.

Facing this limitation, some of the organizations active in gas-turbine development are now investigating direct firing with pulverized coal. They have released no progress reports, but the obstacles faced are known to be serious.

Whether or not gas turbines can be fired successfully with pulverized coal, completely gasified coal remains a likely alternative solution of the cheap-fuel problem. In its essential elements, the complete gasification of coal is one of the simplest operations in fuel technology, and it has been accomplished commercially for nearly a century by two methods—the water-gas process and the producer-gas process.

At present, efficiency considerations favor producer gas. Without elaborate heat-recovery devices a modern gas producer will deliver, in cold washed gas, about 75% of the heat units in the coal charged. The average water-gas generator, on the other hand, converts considerably less, unless elaborately equipped with heat-recovery devices.

This is a good place to answer the inevitable question: If the water-gas process is less efficient than the producer-gas process, why is water gas, rather than producer gas, the major constituent of manufactured city gas? The answer is easy: Plain water gas runs about 300 Btu per cu ft, more than double the heat value of producer gas. As normally carbureted with oil for general distribution, it averages better than 500 Btu. The lean producer gas would cost much more to distribute, requiring larger mains. Also it would be less suitable for domestic gas stoves and certain industrial gas applications.

If large central-station gas turbines ever burn gas transported from the coal mines, it will likely be either water gas or some still richer variety of "gasified coal." If, on the other hand, the coal itself is hauled to the power station, the higher conversion efficiency should give producer gas the advantage over water gas, for the leanness of producer gas would no longer be a handicap.

At this point some may say that power will be lost in compressing the large volume of lean gas that must be supplied to the burner of the gas-turbine *combustor*. Actually the net compression work of a gas-turbine plant is not increased importantly by the use of lean fuel gas. This paradox will be explained later, but first let us briefly review the water-gas and producer-gas processes:

Leaving off all the typical modern gadgets for charging the fuel, sealing the generator gas tight, removing ash and poking mechanically, recovering heat, carbureting with gas oil (in the case of water gas) and so on, the simple fire pot, Fig. 1 and 2, can serve either as a water-gas generator or a gas producer, depending on the method of operation.

The Water-Gas Process

Actually the producer-gas process combines the two parts of the intermittent water-gas process into a single continuous process. That is why the water-gas process should be explained first.

In the fire pot, Fig. 1A, is a fuel bed (usually coke) several feet deep. The fire is started and blown with air. The temperature of the coke mass increases until the layer of incandescent carbon is several feet thick. This air blast is 21% oxygen (O_2) by volume and 70% nitrogen (N_2).

The inert nitrogen goes through the generator unchanged. The oxygen burns mainly to CO_2 but partly to CO. This reaction gives off heat (chemists call it *exothermic*). While a substantial part of the released heat is stored in the rising temperature of the fuel bed, much is lost because the hot *air gas* produced (nitrogen, CO_2 and a little CO) must be wasted to atmosphere.

When the fuel bed is hot enough to react properly with steam, the air blow is stopped and the generator is blown with steam (H_2O). Contact with the incandescent carbon of the fuel bed splits this steam into its constituent hydrogen and oxygen. Most of the hydrogen goes through without further change. The oxygen combines with the carbon of the fuel bed to form carbon monoxide or carbon dioxide, or a mixture of the two.

This useful gas production during the steam blow is stored as *water gas*. Ideally, it is almost half carbon monoxide by volume and half hydrogen, and runs about 300 Btu per cu ft. Carbon dioxide must be kept at a low level. The

Fuel for Gas Turbines?

By PHILIP W SWAIN, *Editor*

best condition for high carbon monoxide and low carbon dioxide is a very deep and very hot fuel bed. The carbon dioxide is generated mainly in the lower part of the fuel bed and is then gradually reduced to carbon monoxide as the gas rises through the upper layers of incandescent carbon.

The production of water gas from steam and hot carbon is an *endothermic reaction*, one that soaks up heat from surrounding solids. That is why the steam blow cools the coke bed. After two or three minutes of steam blow excessive CO_2 production indicates that the fuel bed is too cold for further water-gas production.

At this point the steam blow stops and the generator shifts back to air blow. Again, the resulting air gas must be vented to atmosphere, while the fuel bed is reheated to a suitable temperature for water-gas production. This, then, is an intermittent process, the complete cycle varying from 5 to 8 min.

As compared with the producer-gas process, the water-gas process is wasteful chiefly because the hot-air gas is vented to atmosphere. Some of this heat, however, can be recovered by waste-heat boilers or heat exchangers.

The producer-gas process eliminates much of this waste by combining the air-gas (heat-producing) reaction and the water-gas (heat-absorbing) reaction into a single continuous process, so that the heat given off by one supplies that absorbed by the other. This is the producer-gas process shown schematically in Fig. 2. For the sake of clearness, separate product paths are pictured for H_2O, N_2 and O_2. In actual operation, of course, these paths mix throughout.

How Producer Works

The producer is blown continuously with air and steam mixed in suitable proportions. The nitrogen of the air goes through the fuel bed unchanged. The oxygen burns to CO_2 in the lower part of the fuel bed, and is then largely reduced to CO as it works up through the incandescent carbon in the reduction zone. This is exactly the same as the air-gas reaction of the water-gas cycle. Meanwhile the steam fraction of the blast breaks down into hydrogen and oxygen. The oxygen burns first to CO_2, then reduces largely to CO.

If raw bituminous coal is used instead of coke, the green fuel in the top layer is cooked by the rising hot gases, so that its volatile constituents add methane and tar to the gas. The tar is normally removed from the gas before use, but the methane remains to boost the heat value of the hot gases.

Producer gas generally contains about 50% nitrogen from the air supplied. While the low-heating value resulting from this dilution makes producer gas unsuitable for general distribution, it will not ordinarily be a real handicap for firing gas-turbines close to the producer.

The need to compress a large volume of the lean producer gas for gas-turbine fuel has been mentioned. The effect of this requirement on the efficiency of the gas-turbine plant must be considered. First, for a constant efficiency, note that the volume of fuel gas to be compressed per net horsepower of plant output will be inversely proportional to the heat value of the fuel.

For example, suppose that the net heat consumption per kwhr is 12,000 Btu (over-all thermal efficiency of 28.4%), then the cu ft of fuel to be compressed per kwhr is:

Fuel	*Btu per cu ft*	*Cu ft per kwhr*
Fuel oil	....	Negligible
Natural gas	1000	12
Plain water gas	300	40
Producer gas	140	86
Blast-furnace gas	95	126

This tabulation might appear to

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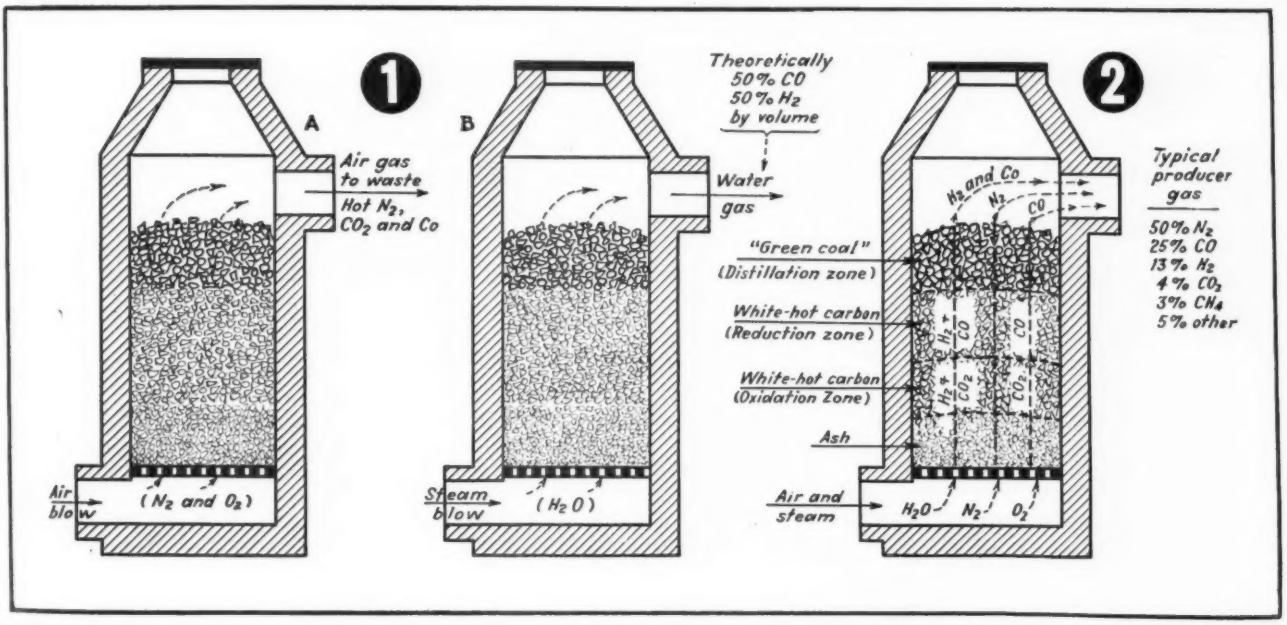


Fig. 1—This simple water-gas generator, diagrammed without mechanical refinements, first blows the hot coke-fuel bed with air (A) to raise its temperature. Resulting *air gas* is vented to waste. Next, steam blow (B) produces water gas, meanwhile cooling the fuel bed to a point where another air-blow must start a new cycle. Fig. 2—Constructed like the water-gas generator, this elementary gas producer operates differently. Air-gas and water-gas reactions combine for continuous operation. Heat absorbed by water-gas reaction is at once supplied by air-gas reaction to insure high efficiency. Typical produces gas analyzes as shown

It's Easy to Check Flowmeter Accuracy

William C Bennett, manager, appliance division, Cochrane Corp, gives a table of differential-pressure values that includes all types of head flowmeters and shows how to use these data when making simple meter calibration tests

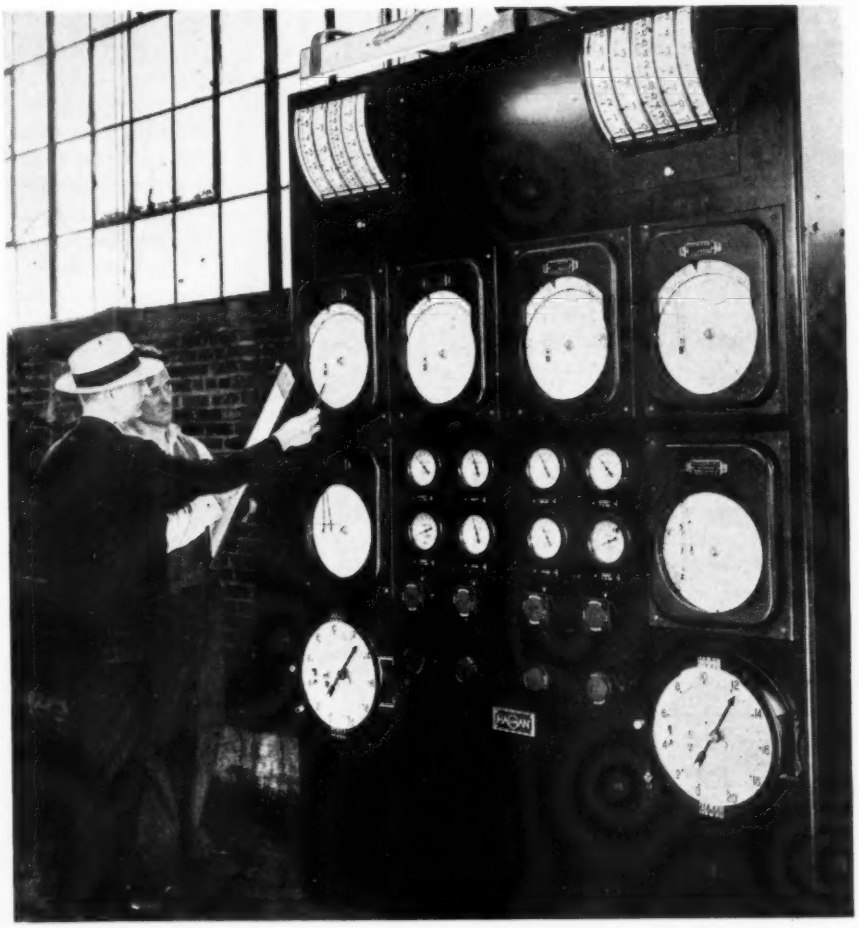
►HEAD-RATE FLOWMETERS have an advantage over temperature and pressure instruments in that the user can check their accuracy with relatively simple and inexpensive equipment. Calibrating baths for either temperature or dead-weight testers for pressure are not usually available in smaller plants. For verifying differential-pressure readings of flowmeters, however, the engineer of any plant can construct an accurate water-column with glass tubing, rubber hose, a few valves and fittings and an inch scale of suitable length. Except for some refinements, such a setup is practically the same as the best-equipped manufacturer uses.

Accuracy of Flowmeters

Proof that a flowmeter is accurate as a differential-pressure measuring device does not necessarily mean that it will measure flow accurately when installed. The meter is the secondary device and its primary element (orifice plate, flow nozzle or venturi tube) must be accurate and correctly installed and maintained. Also, differential pressure of the primary element must reach the secondary element unimpaired by connecting piping and fittings. Causes of errors in readings were covered in "How to Keep Flowmeters Accurate," an 8-page section, August, 1943, POWER. When checking an installation for accuracy, you can readily apply a calibration test to the meter, thereby eliminating it as the source of suspected error, following which balance of the installation can be checked.

All head flowmeters contain some form of mercury-manometer U-tube connected to a differential-head device, such as a plate orifice, or nozzle, in the flow line, Fig. 1 and 2. In these figures, the high-pressure line from the differential device connects to the left-hand leg of the manometer and the right-hand line to right-hand leg, or float chamber.

When flow increases, Fig. 1, differential pressure across the orifice increases, which causes the mercury to rise in the float chamber, until the differential head of mercury and water balances the differential head across the orifice. As the mercury rises it lifts float *F*, which through lever *L* turns shaft *S* through a small arc to position the indictor, recorder or integrator. There are many designs and makes of head flowmeters but basically they all operate on the principle in Fig. 1.



The user can check accuracy of flowmeters with relatively simple and inexpensive equipment, so if you have doubts about their readings make a calibration test

To insure flowmeters operating under constant conditions, when connected for measuring steam or water, locate the meter so that its connections will always be full of water. One way is to locate the meter below the differential device, Fig. 1. To be connected this way a meter must be wet calibrated. That is, when field tested it must be calibrated with its manometer and connecting piping full of water above the mercury.

For gas or air measurements, locate the meter to keep all moisture out of its manometer, which may be done by arranging the connecting piping as in Fig. 2. Such meters are dry calibrated, that is, they have only mercury in the manometer.

In a wet-calibrated meter, air trapped in the meter connections causes an error in readings. Conversely, if condensate gets into a dry-calibrated-meter manometer it also causes an error in readings. Guard against these conditions carefully when calibrating and installing flowmeters.

Flowmeters are built for definite differential pressure ranges. Even though mercury is used in the manometer to measure differential pressure, it is

standard practice to express the meter's differential range in inches of water. This range is printed on each meter's name plate, or can be found in its instruction book. Ranges for different makes of meters are given in the flowmeter table on page 134, in the columns headed 100%-scale reading.

This table was compiled from values published in the instruction books of most flowmeter manufacturers. In the right-hand half of the table 10 differential pressures are given between 10- and 100%-scale reading for wet calibration, and the left-hand half gives a similar range for dry-calibrated meters.

The center column in the table gives the differential pressure in inches of mercury corresponding to 100%-scale reading of each meter when dry or wet calibrated. For example, go down the 100% dry-calibration column until you find 50.00. This means that it requires a differential pressure equal to 50 in. of water to cause the meter to give a full-scale reading. Mercury has a specific gravity of 13.56, so that in the mercury column we find the differential pressures given as $50 \div 13.56 = 3.687$ in.

Continuing with this meter, assume we have it on test. If we applied a 50-in. differential to it, the pointer on the indicator, or the pen on the recorder should move to full-scale position if the meter is correctly calibrated. This meter requires a 32-in. differential pressure to position its pen or pointer to 80%-scale position, as shown in the 80% column. At 50%-scale reading the differential pressure drops to 12.5 in. of water and at 10%-scale reading to 0.5 in. if the meter is correctly calibrated.

From these values, we see that the differential pressure changes much faster than the flow. For example, on our 50-in. meter, differential pressure at 50%-scale reading is 12.5, while at 100% scale it is 50, or four times as much. This is because the differential pressure does not vary as the flow, but as the flow squared. This law makes it easy to calculate the differential pressure for any percent-scale reading from the name-plate data. We can find percent values of differential head by squaring the percent flow and dividing by 100. For example, 50% flow requires $50 \times 50 \div 100 = 25\%$ of the differential head at 100% flow. That is, the differential head on an 81.36-in. dry-calibrated meter at 50% flow is $81.36 \times 0.25 = 20.34$ in. as given in the table. If the wet-calibrated meter at 100% scale requires 75.36-in. differential head, then at 50% scale the differential head will be $75.36 \times 0.25 = 18.84$ in., as given in the table.

A flowmeter is the same in its basic calibration whether used to measure water or steam (wet calibration) or to measure air or gas (dry calibration). It is in the orifice plate or nozzle calculations that the distinction is made. Orifice bore or nozzle size is different for a wet- than for a dry-calibrated meter, because this calculation uses effective differential range which is less for wet than for dry calibration. For example, in the table a meter, which on dry calibration can measure a maximum of 81.36 in. water differential will only measure 75.36 in. on wet. Fig. 3 makes this clear. Here, with equal pressure on wet and dry manometers, the wet-calibrated manometer reads higher,

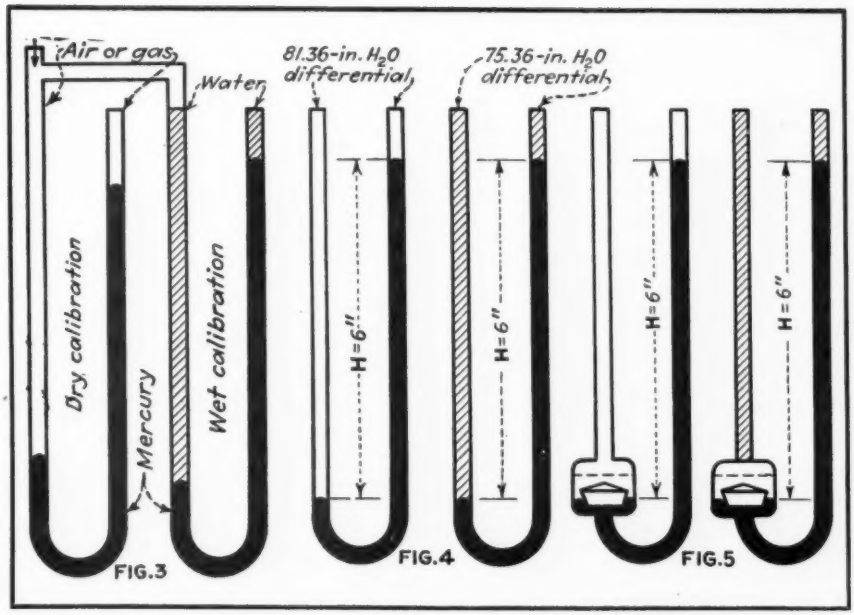


Fig. 3—With the same differential pressure, the mercury column goes higher on wet than on dry calibration. Fig. 4—To obtain the same deflection of a mercury manometer, higher differential pressure is required when dry calibrated than when wet. Fig. 5—Same as Fig. 4 except that it has a meter float chamber in circuit

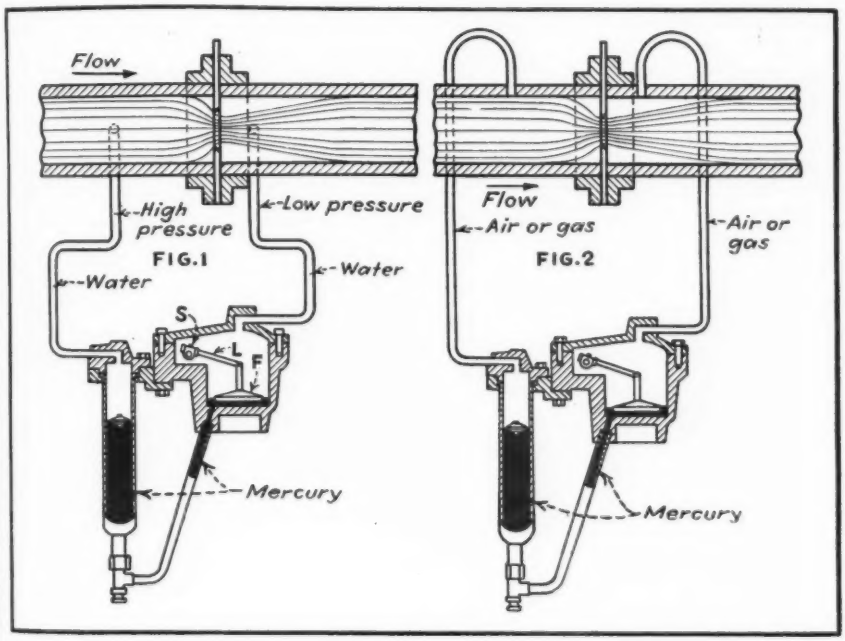


Fig. 1—Diagram of flowmeter manometer connected for steam- or water-flow measurement. Fig. 2—Diagram of flowmeter connected for air- or gas-flow measurement

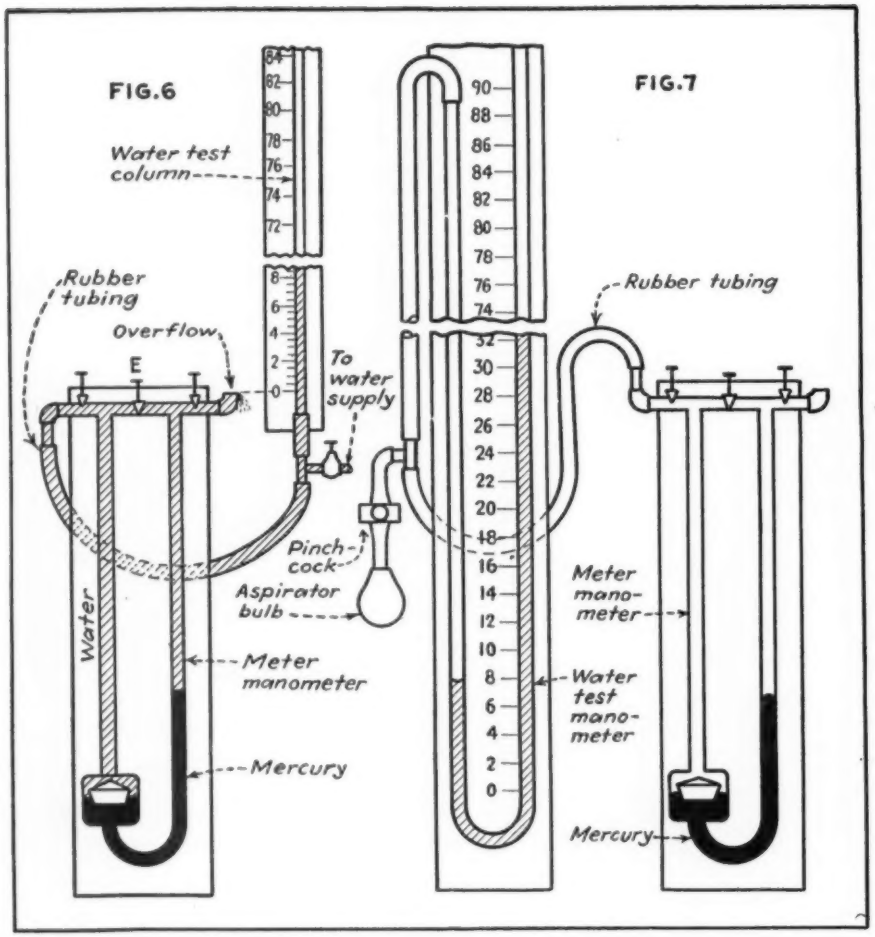


Fig. 6—Diagram of equipment for making a wet calibration of a flowmeter manometer. Fig. 7—Diagram of equipment for making a dry calibration of a flowmeter

because of the unbalanced leg of water.

For wet and dry manometers to reach the same readings, a higher differential must be applied to the dry than to the wet. For example, in Fig. 4, assume a differential pressure $H = 6$ in. of mercury. To obtain this differential in the manometer, pressure in the left-hand leg must be equal to 6 in. of mercury. Specific gravity of mercury is 13.56, that is, 13.56 times as heavy as water. Therefore, a 6-in. column equals the weight of $13.56 \times 6 = 81.36$ in. of water (dry calibration), the value left of 6.000 in the mercury column, in the center of the table, page 134.

Wet-Calibrated Manometer

In the wet-calibrated manometer a column of water equal to the height of the mercury column adds to the differential pressure. Consequently, to maintain a 6-in. mercury column with wet calibration, the differential need be only that for dry calibration minus a column of water equal to the head H, or here, 6 in. For the dry-calibrated manometer, differential was 81.36 in. of water. Then for the wet-calibrated, differential is that for the dry-calibrated, minus 6, or $81.36 - 6 = 75.36$ in., as in the table.

Another way of looking at this problem is to assume that the specific gravity of mercury 13.56 is reduced by that of water, 1, or to $13.56 - 1 = 12.56$. Then, multiply this value by the differential head of mercury in inches, which in our problem is 6. This gives a differential in inches of water $12.56 \times 6 = 75.36$ in., as in the 100% wet-calibration column.

To add another step, Fig. 5 shows diagrammatically two identical flowmeter manometers. In both it has been assumed that the mercury level in the float chamber moves down 1 in. to cause a total deflection of the meter and differential-head change of 6 in. of mercury. Under dry conditions, the differential pressure acting on the float chamber is $6 \times 13.56 = 81.36$ in. of water; for wet calibration, $6 \times 12.56 = 75.36$ in. of water.

General procedure for testing flowmeters is simple. First, cut the meter out of service by closing the valves in the high-and low-pressure connections to the meter. Then open the equalizing valve between these connections. When this is done, if the pointer on an indicating meter, or the recorder pen, does not come to zero, correct the fault by adjustment or removal of other causes.

Then, disconnect the meter and test it in place or in a convenient location. If it is wet calibrated, connect the meter to a suitable gage, as in Fig. 6. Set zero on the gage level with the overflow on the low-pressure connection of the manometer. When the equipment has been properly set up, with the equalizing valve E open, slowly admit water into the system and let it run out of the overflow to insure removal of all air.

Close the equalizing valve and fill the gage to give a head corresponding to 30% meter reading. If it is a 75.36-in. meter, then at 30% flow the differential head is 6.78 in. of water. With the gage glass filled to that mark, the meter should read 30% scale range. Make a record of the reading. Then fill the gage to the 18.84-in. mark, which is the 50% meter-range differential as obtained from the table. Read the meter again and raise the gage head to 48.23 in. Now the meter should read 80% of its scale range. Finally, increase the gage head to 75.36 in. at which point the meter should read full scale.

To check for lag between up and down readings, slightly open equalizer valve E and drain the water down in the gage glass to 48.23 in. Note whether the meter reads down scale the same as it did up scale. Readings should be practically the same, contingent upon the amount of friction present in the metering mechanism. Take other readings on the down scale until the gage level has been returned to zero. If there are serious errors in the meter's reading, correct them according to the manufacturer's instructions.

Dry Calibration

For dry calibration, use an arrangement like Fig. 7. Here a U-tube water manometer is set up near the meter and connected by suitable rubber tubing. Fill the U-tube about half full of water. Do not permit water to enter the manometer. Pressure is built up simultaneously in the meter manometer and the test manometer by using an aspirator bulb or a bicycle pump. Differential head on the meter is determined by the difference in water level in the two legs of the test manometer. The meter is checked as previously described for wet calibration. After correct pressure has been established, use a pinch cock on the rubber tubing to hold the pressure of a particular reading.

50,000-Kw Gas Turbines After the War?

A survey of potentialities of the continuous-combustion gas-turbine cycle for power, propulsion and process use, by F K Fischer and C A Meyer, Westinghouse Electric and Mfg Co

▶ THE COMBUSTION GAS TURBINE in its basic form comprises three major elements: a compressor, a combustor and a gas turbine, plus a generator and a means of starting. This simple arrangement constitutes an open-cycle system. A starting motor is required to turn the compressor at part speed to supply air for combustion; when the unit is in operation the energy to drive the compressor comes from expansion of products of combustion in the gas turbine.

In the simple cycle operating at 1200 F, the products of combustion contain some 600% excess air. After expansion in the turbine, products of combustion are exhausted to the atmosphere. No intermediate fluid is used as in the steam cycle. Compressor and combustor take the place of the steam boiler, resulting in a much smaller and more compact power plant. Because the simple open combustion gas cycle requires no cooling water, plants can be located without regard to rivers or lakes.

Materials are now available that are capable of operating at high temperatures. The maximum temperature employed is largely a question of expected useful life. For some military needs a life of relatively few hours may suffice and temperatures of the order of 2000 F are allowable. Heavy duty or long life applications are limited to a much lower temperature. Advances in metallurgy incidental to war needs will undoubtedly produce materials capable of operation at temperatures that would not have been attained for many years under normal peacetime development.

Compressor Efficiency

The combustion gas turbine circulates tremendous volumes of gas. The axial flow compressor, small in physical size, efficiently handles the large volumes required. Development of efficient air-foil sections have given the designer a highly efficient compressor.

Useful power output depends upon obtaining relatively high turbine and compressor efficiency. Net output is the difference between two large quantities, that is, the gross turbine output less the work required by the compressor. The compressor requires, in the simple open cycle at 1200 F, about three quarters of the turbine output. An improvement of 1% in both turbine and compressor efficiencies increases net output 7% for the same physical size and fuel consumption.

Fig. 1 shows the simple gas cycle thermal efficiency against pressure ratio for several turbine inlet temperatures. Curves are based on blade efficiencies of 85% for the turbine and 84% for the compressor with an assumed condition of perfect combustion and air inlet temperature of 70 F. Maximum efficiency, as will be seen from the curves, for temperatures less than 1200 F, occurs at pressure ratios less than 6, which means that pressures in open-cycle units will normally be less than 100 psi. Low pressure results in large gas volumes and relatively large turbine blade dimensions.

There are three practical ways of improving efficiency of power units above that of the simple cycle of Fig. 1. Adding a heat exchanger of about 0.3 cu ft volume per kw net output to transfer some of the heat from the exhaust to the air entering the combustor parallels the air preheater of a steam boiler and recovers about 75% of the heat avail-

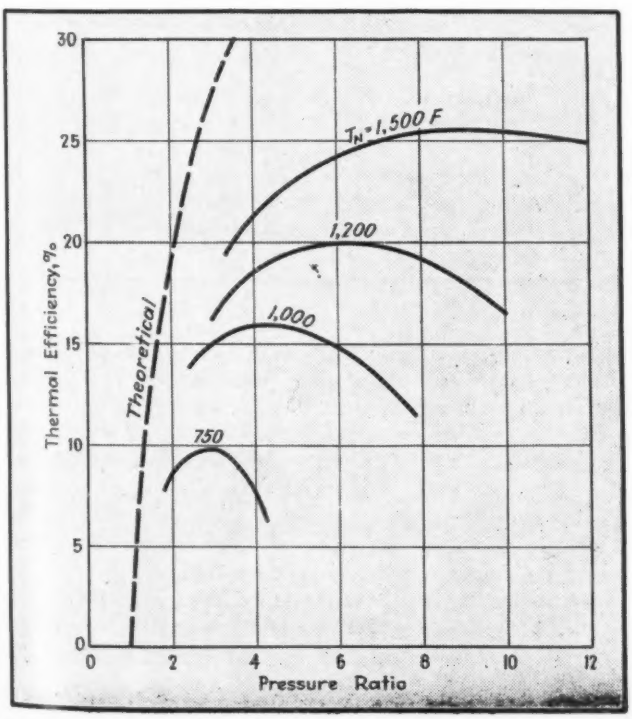
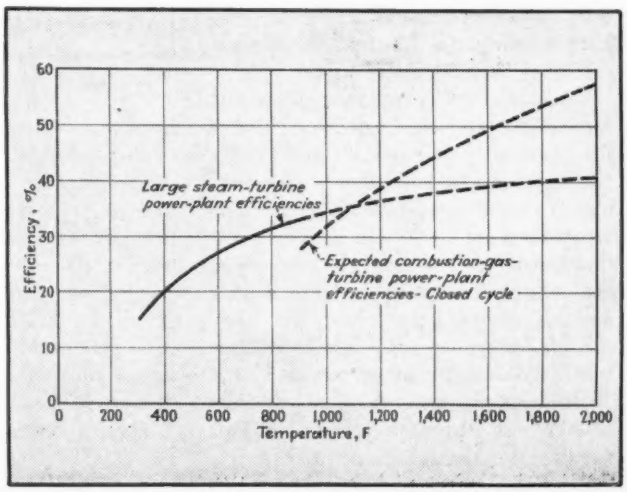


Fig. 1—Effect of pressure ratio and temperature on thermal efficiency of open-cycle gas turbines. Assumed blading efficiency of turbine 85%, compressor 84%, fuel combustor 100%

Fig. 2—Efficiencies of best practical steam power plants and combustion-gas-turbine plants projected to operating temperatures up to 2000 F to indicate greater gain for the latter



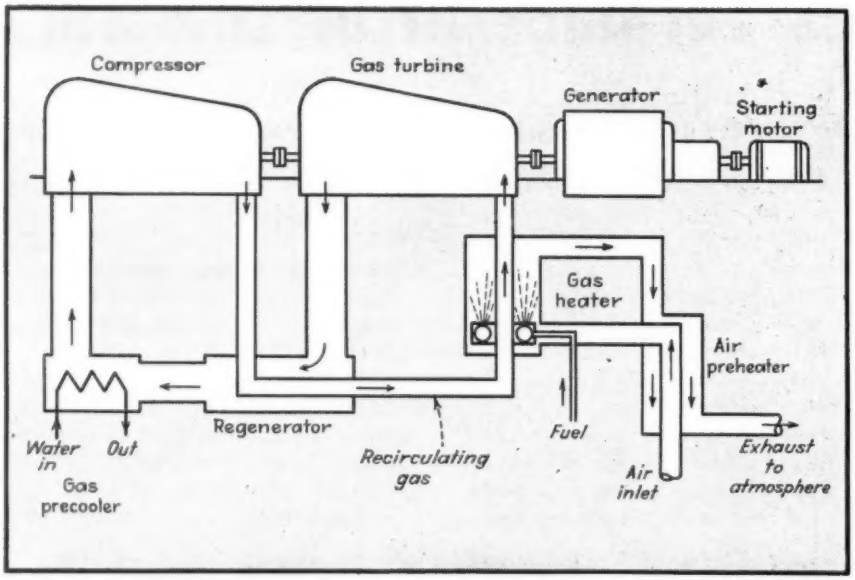


Fig. 3—Externally fired closed cycle proposed by Escher Wyss requires water cooling but avoids circulating products of combustion through gas turbine

able from the turbine exhaust gas.

A second improvement is effected by intercooling, a familiar practice in air compression. Water is necessary for intercooling, a slight disadvantage, but a single intercooler reduces compressor work by some 15%, a considerable improvement in both efficiency and capacity.

A third practical improvement corresponds to reheat in steam turbine plants, but is accomplished in the gas cycle by burning additional fuel directly in the gas (approximately 85% air) leaving the higher pressure stages of the gas turbine.

Reducing Gas Circulation

Reheating and intercooling increase the amount of useful energy per lb of fluid passing through the system and thus reduce the amount of working fluid circulated. Size of piping and blade path in compressor and turbine are reduced as is the heat exchanger for equal heat recovery. All three aid in maintaining efficiency at partial loads.

Effect of cycle arrangement on full-load efficiency is indicated in Table I, for equal generator outputs and 1200 F temperature. An idea of how these efficiencies compare with a 3600-rpm 5000-kw steam plant is given in Table II. Note that the large flow and low pressure of the gas turbine results in large volume flow which means that piping and blading of the gas turbine inlet are large compared with the steam turbine.

However, the ratio of exhaust to inlet volume is small for the gas turbine. This requires a balanced blade path unlike that of the steam turbine which must handle an exhaust volume of the order of 250 times inlet volume.

Temperature of inlet air to the compressor has a marked effect on cycle efficiency. The colder the inlet air, the higher the cycle efficiency and the greater the capacity of a machine of given physical dimensions. In the simple open cycle, changing the inlet-air temperature 10 F changes the cycle efficiency 0.74 points, or about 3%.

Another point of interest about gas turbines is their inherent better efficiency as inlet temperatures can be increased. The steam cycle theoretically offers an efficiency approaching that of the Carnot cycle only up to critical pressure and temperature (3206 psi, 705.4 F). Above this limit the gap between steam cycle and ideal cycle widens. Fig. 2 compares best efficiencies obtained in large central station power plants (projected to 2000 F) with the expected practical limit in efficiency of large-capacity closed-cycle combustion-gas-turbine power plants. Above 1000 F the gas cycle efficiency increases about three times as fast as that of the steam cycle for a given increase in throttle or inlet pressure.

The closed cycle of Escher Wyss (Switzerland) offers a method of increasing maximum capacity of gas turbines otherwise limited to about 7,500 kw. (A system of liquid injection in the cycle will undoubtedly get around the 7500-kw limitation also.) The volume of working gas is inversely proportional to its absolute pressure; that is, if pressure is multiplied by ten, size is divided by ten. In the closed cycle, the working gas can be circulated at relatively high pressure. Physical sizes of turbine and compressor are smaller for a given rating; or, conversely, a given size machine can produce more output.

On the other hand, the closed cycle requires cooling water to reduce temperature of gas before it enters the compressor. The amount of heat to be removed is the equivalent of that re-

Table I—Open-cycle Arrangements

Item	*Simple cycle*	*Cycle with regeneration*	*Intercool and regenerate*	*Reheat and regenerate*	*Intercool, reheat and regenerate*
Input in fuel	4.95	3.75	3.43	3.55	3.11
Turbine rating	3.95	2.95	2.80	2.88	2.55
Compressor power	2.95	1.95	1.80	1.88	1.58
Useful output	1.00	1.00	1.00	1.00	1.00
Efficiency, %	20.2	26.6	29.2	28.1	32.2
Gas temperature, F					
Turbine inlet	1200	1200	1200	1200	1200
Leaving reheater	....	....	....	1200	1200
Turbine exhaust	635	790	695	920	865
Leaving regenerator	....	455	350	560	520
Air temperature, F					
Compressor inlet	70	70	70	70	70
Leaving intercooler	....	....	70	....	70
Leaving compressor	490	340	230	440	405
Entering combustor	490	680	575	800	750
Pressure, psi					
Compressor inlet	14.7	14.7	14.7	14.7	14.7
Compressor discharge	88.2	51.5	73.5	73.5	102.9
Turbine inlet	88.2	50.2	71.7	71.7	100.4
Turbine exhaust	14.7	15.1	15.1	15.1	15.1

jected by the condenser of a steam unit of equal capacity. However, the *quantity* of cooling water will be less than for a steam plant as a higher water temperature rise is permissible.

In the closed cycle, compressor inlet pressure might be maintained at about 150 psi and discharge pressure about 600 psi. If the system is externally fired, some gas other than air might be used; hydrogen, for example, has a density only one fourteenth that of air but a specific heat 14 times as great and a thermal conductivity 6.8 that of air.

New Closed Cycle System

A somewhat different closed-cycle system is being studied by Westinghouse engineers, Fig. 4. A high-pressure turbine and compressor operating between 150-and 600-psi pressure limits is kept *pumped* up by an auxiliary gas turbine and compressor that supplies makeup air to support combustion in the main circuit by bleeding off part of the hot gas to exhaust. The main gas turbine and compressor are physically small as they operate at high pressure. The cycle is internally fired as products of combustion pass through gas turbine and main compressor. This cycle avoids the large gas heater required by the Escher Wyss cycle but requires an extra gas turbine and compressor to pump up the system.

Use of regenerators, reheaters and intercoolers, in addition to improving full-load economy, results in better partial load efficiency. In the closed cycle practically full-load efficiency can be maintained at partial loads by reducing the gas pressure as load is reduced.

Possible applications of the gas turbine are many. Ranging from a simple open-cycle unit for locomotive and airplane drive to a large-capacity closed-cycle plant including regeneration, reheat and intercooling for stationary power generation, the gas turbine offers a wide range of possibilities.

For locomotives, the gas turbine has low weight and space requirements, is inherently a simple machine and requires no water. With an efficiency of about 20% at 1200 F and the expected low maintenance of turbine drives, it compares favorably with present prime movers. However, the inability of the gas turbine to operate in reverse makes either electric drive or the development of a satisfactory reversing gear necessary for this application.

Operating at high speed and high temperature, the gas turbine can power airplanes of any size at low weight per unit rating. It is capable of output well beyond the range of maximum piston-engine sizes. High-octane fuel is not required. The gas turbine can power a convential propeller or its output can be utilized for jet propulsion.

For ship drives, the gas turbine offers efficiencies equal to the best modern marine steam power plants which have over-all efficiencies of approximately 25%. Weight and space requirements of equipment are a real factor in ship drive and the gas turbine eliminates both steam generator and steam condenser. The requirement of astern op-

(*Continued on page* 156)

Table II—Comparison of Steam and Gas Turbine Plant 5000 kw rating—3600 rpm

Item	*Open cycle gas turbine*			*Steam turbine*
	Simple cycle	One reheat, one intercool, and regeneration		3 stages of feed water htg
	Single cyl	H-p turbine	L-p turbine	Single cyl
Inlet pressure, psi	88.2	100.4	39.4	465
Inlet temperature, F	1200	1200	1200	825
Exhaust pressure, psi	14.7	39.4	15.1	0.75
Steam or gas rate, lb per kwhr	102	56		10.5
Full-load flow, lb per hr	510,000	280,000		52,500
Inlet flow, cu ft per sec	990	475		24.8
Exhaust flow, cu ft per sec	3900		3250	6120
Ratio exhaust to inlet volume	3.95	6.85		250
Turbine floor area, sq ft	160	150	155	100+
Net generator output, kw	5000	5000		5000
Plant thermal efficiency,%	18.4++	29.4++		23.6

\+ Turbine room only ++ Inlet air temperature 70 F

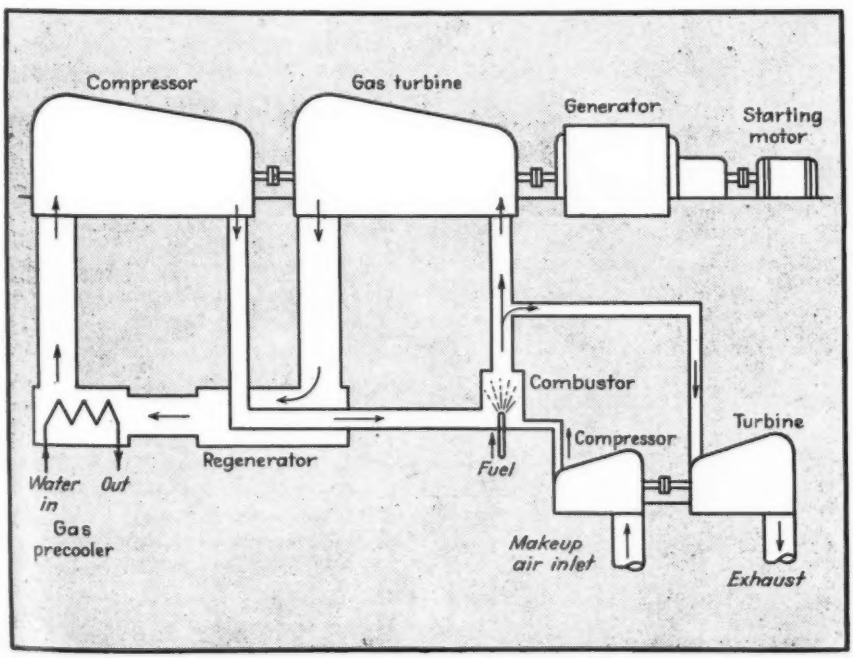
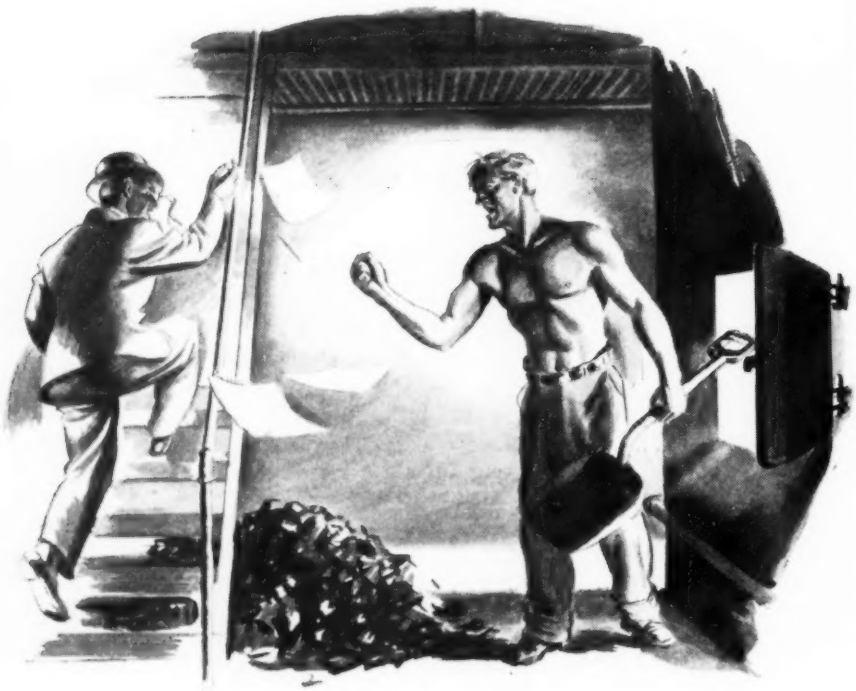


Fig. 4—Internally fired closed cycle in which auxiliary gas turbine and compressor supply makeup air to support combustion in high-pressure circuit

THE OLD CHIEF

BIG MEN



The astonished visitor legged it up the stairs

Besides being able to lick the tar out of any of his men, the holder of the title, Boss Fireman, had other claims to size

By WILLIAM DORAN, *chief engineer, Essex Co Sanatorium, Windsor, Ont.*

AWAY BACK IN THE DAYS when our battery of six boilers were fired by hand, we were always on the lookout for good firemen. We hired them in much the same way that we purchased our horses; that is to say, we liked them *big and rangy*. The horses had to haul the coal up a steep hill from the dock to the plant and the job of winging over a fire, dislodging heavy clinkers and hooking them out, certainly placed our firemen within the ranks of the heavyweight division. The only educational requirement imposed on our budding combustion experts was that they should have a *thorough knowledge of the business end of a shovel.*

Men with marine firing experience were preferred, but the majority graduated from the honorable profession of *coal trimmers.* The latter were responsible for wheeling the coal from the bunkers to the firemen, helping to wheel away the clinkers and ashes and keeping the place reasonably clean with the aid of a heavy hose line.

The man who was charged with the smooth running of the boiler room and for the maintenance at all times of the pressure (precious) line, in accordance with the chart pinned to the blackboard—and who was further responsible to the Old Chief for anything else that might or might not happen in the boiler room—was not known to us by any such title as department manager, foreman, subforeman or leader. He was known as Boss Fireman. And mark you, my public relations friends of today, acceptance of the title of Boss at the turn of the century implied that the holder of said title could if duly called upon lick the tar out of any man working for him. It was also the duty of the Boss to personally handle number six boiler; while the other boilers on the line fired steadily, he kept the pressure line on the dot by his skillful manhandling of number six.

I can close my eyes today and, down on the poorly lighted firing floor, see those big fellows sweating. A furnace door would swing open and the red glare would make them look like giants as they moved methodically about their duties. Of all the Boss Firemen I knew, I think that Red Hogan was the most efficient and certainly he was the most colorful we ever had.

Find the Boss

They used to say that if you ever wanted to find out who was the boss, all you had to do was *start something.* I discovered the truth of this when I was sent as guide to an insurance adjuster who wished to interview a fireman named Jankinnen about a minor compensation claim. Poor Jan did not understand much of what the adjuster was talking about and I noticed that Red Hogan was circling us with a gleam in his eye. So when the insurance man started to badger and browbeat old Jan, I was not surprised at what followed. Red flipped open one of the furnace doors and shaking his hamlike fist before the astonished clerk, he promised to throw him in the fire if he was not out of the boiler room in five seconds. The visitor legged it up the stairs without waiting to pick up his pencils.

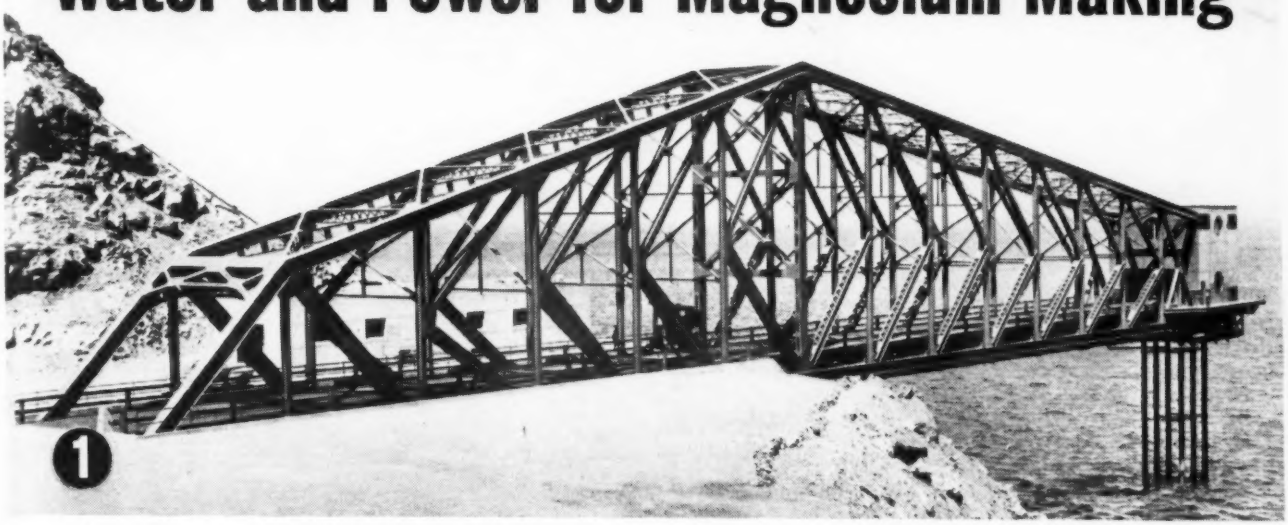
This incident was typical of Red's attitude towards anyone who did not belong to the powerhouse. Everyone except those who worked with him thought that he was an objectionable sort of person.

One bitterly cold day I was checking coal deliveries when a half-frozen teamster came in to have his docket signed. The poor old fellow was blue in the face and his hands were so numb I had to help him take the delivery ticket out of his pocket. I advised him to step down to the boiler room and thaw out before returning to the dock.

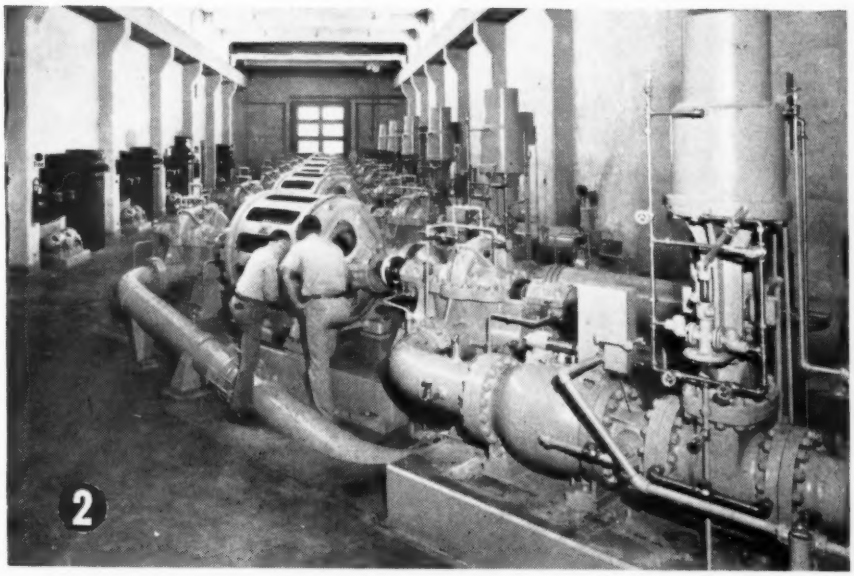
I was busy with something else when I remembered that Red Hogan was on duty. Knowing his attitude toward strangers, I slipped down to see how the driver was making out. About half way down I came abreast of the men's dressing room where Red was buttoning the old man into his own leather-lined Mackinaw. As they went towards the side exit, I saw that Red had his leather cap with the ear flaps, his driving gloves

(*Continued on page* 140)

Water and Power for Magnesium Making

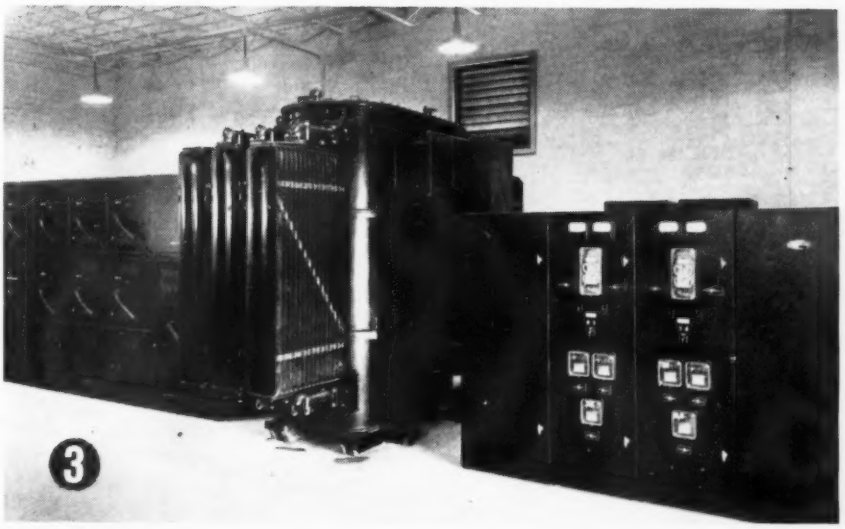


To keep ingots of precious light metals flowing from the vast Basic Magnesium plant, Las Vegas, Nevada, requires 23 million gpd of Lake Mead water and more than 4 million kwhr daily from Boulder Dam's output



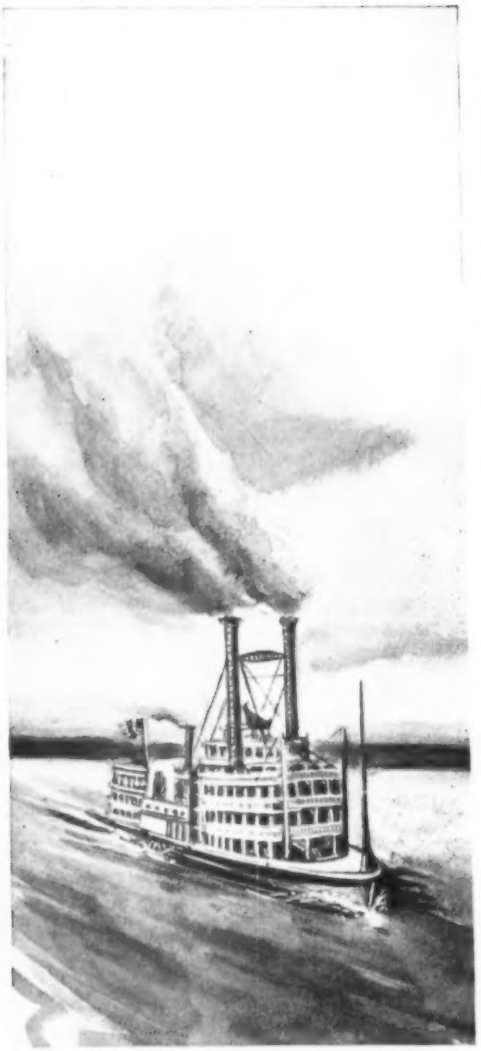
1 Water for cooling equipment and washing materials during chemical and electrical processes at the vast new plant of Basic Magnesium, Inc, comes from Lake Mead, behind Boulder Dam in Nevada. These six intakes, reaching 190 ft into the lake on a cantilever structure, serve as suction for pumps in nearby booster station

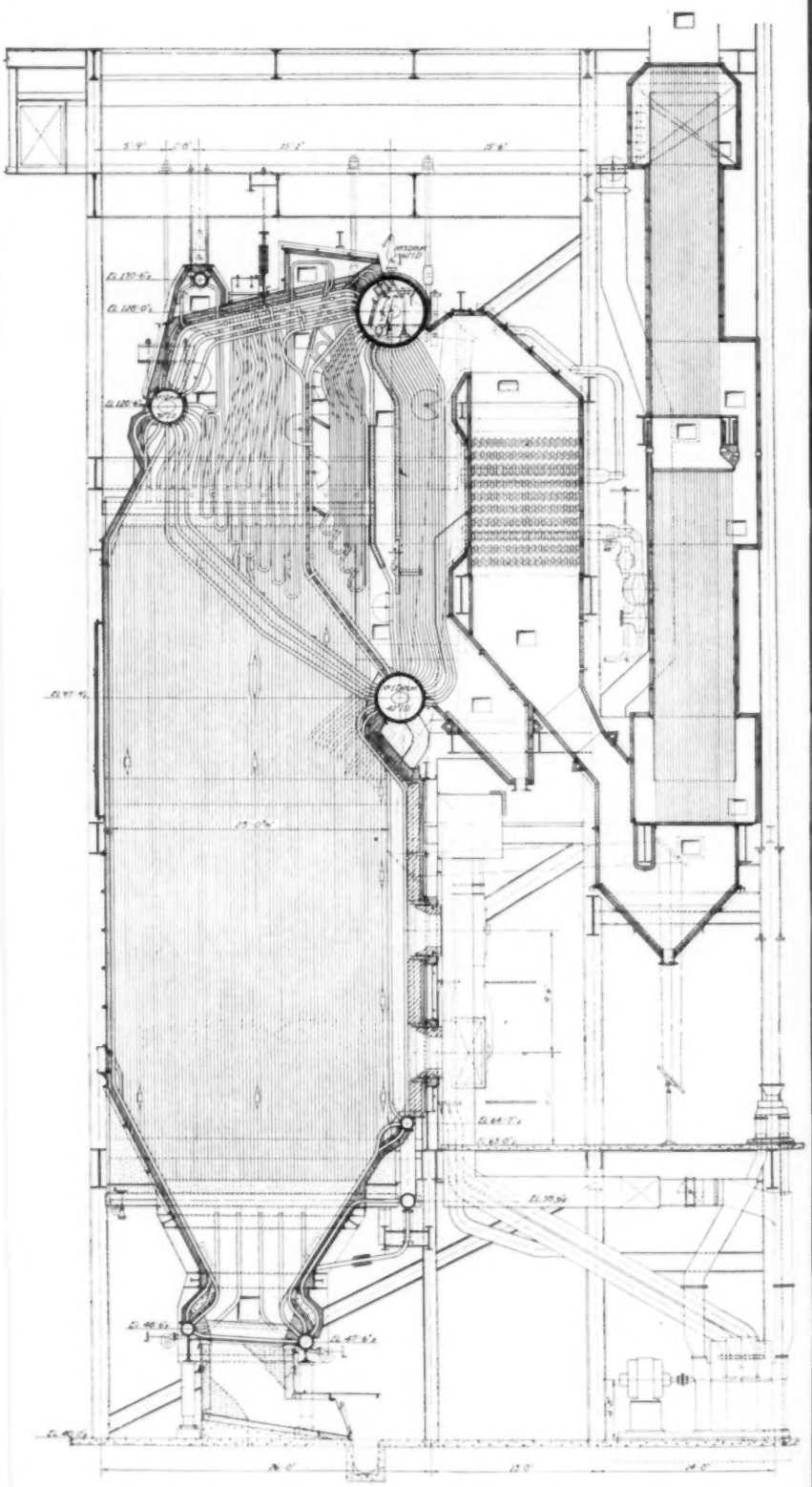
2 At the booster station, six Byron-Jackson centrifugal pumps, driven by 1250-hp Westinghouse synchronous motors, force 23 million gpd through a 40-in. underground pipeline which rises 800 ft over intervening hills and then runs 15 miles across the mesa to the magnesium plant at Las Vegas. Power for the motors comes from Boulder Dam units by way of Basic Magnesium's substation



3 Making chlorine is a necessary preliminary to producing magnesium. At this plant, 400 tons of salt go into brine each day, from which chlorine is made by electrolysis. All

at the Venice Station on the Mississippi





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COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

It will pay you to visit modern Riley Installations

results from Riley units exceed guarantees

actual efficiency 88.5%-guaranteed efficiency 86.4%

The majority of Riley steam generating units are operating at appreciably higher efficiencies and capacities than guaranteed. Riley, therefore, not only gives the purchaser his money's worth, but in case after case a significant bonus. On thirty-three recent tests, actual efficiencies of Riley Boiler units exceeded guaranteed efficiencies by an average of 1.576 points, representing thousands of dollars of additional fuel savings to Riley users — an extra dividend to those companies which purchase Riley steam generating units.

Such outstanding performance has brought about a tremendous increase in the use of Riley Boilers by leading industrial and central station companies — a most significant swing to Riley. Complete satisfaction from existing Riley Units has resulted in large numbers of repeat orders — one company 9 different orders for 9 Riley Units; another 7 orders for 20 Riley Units; another 6 orders for 14 Riley Units; another 6 orders for 11 Riley units. Positive proof of the satisfactory results being obtained by users from Riley steam generating units.

In addition to the largest units, Riley also manufactures specially designed units of capacities down to 7500 pounds of steam per hour.

TEST DATA—VENICE STATION

Steam Pressure—Boiler Drum	898°F.
Steam Pressure—Super. Exit	845°F.
Steam Temperature	916°F
Draft of Air Heater Exit	7.2"
Air Pressure Air Heater Inlet	7.6"
Hourly Quantities	
Steam Flow	373,870 lbs.
Weight of Coal	43,890 lbs.
Fuel as Fired—Southern Illinois	10,556 B.T.U.
Heat Balance	
Overall Efficiency	88.5%
Loss due Moisture in Fuel	1.0%
Loss due Hydrogen in Fuel	3.8%
Loss due Moisture in Air	0.1%
Loss due Dry Chimney Gas	4.2%
Loss due Combustible in Ash	.07%
Loss due Radiation and Unaccounted for	1.7%

All of these well-known Companies have installed Riley Boilers

INDUSTRIAL PLANTS

Curtiss-Wright Corp.
Dow Magnesium Co.
Carbide & Carbon Chem. Corp.
General Electric Corp.
Carnegie-Illinois Steel Corp.
American Brass Co.
Allis Chalmers Mfg. Co.
Winchester Repeating Arms Co.
Henry Disston & Sons Co.
Scovill Mfg. Co.
General Motors Corp.
Container Corp.
Norton Company
Masonite Corporation
Celanese Corp. of America
Parke Davis Co.
Kellogg Co.
Beechnut Packing Co.
Standard Oil Co. of New Jersey
Standard Oil Co. of Indiana
Standard Oil Co. of Louisiana
Standard Oil Co. of California
Shell Oil Co.
Western Cartridge Co.
Republic Steel Corp.
New York, New Haven & Hartford R.R.
Campbell Soup Co.
Publicker Commercial Alcohol Co.
Swift & Co.
Ruberoid Co.
Douglas Aircraft Co.

CENTRAL STATION PLANTS

Houston Lighting & Power Co.
Pennsylvania Edison Co.
Carolina Power & Light Co.
Southern Ind. Gas & Electric Co.
Central Illinois Light Co.
Union Electric Co. of Missouri
Union Electric Co. of Illinois
Florida Power & Light Co.
Gulf Power Co.
Mississippi Power Co.
Iowa-Illinois Gas & Electric Co.
Interstate Power Co.
Otter Tail Power Co.
Central Ohio Light & Power Co.
City of Los Angeles, Calif.

RILEY

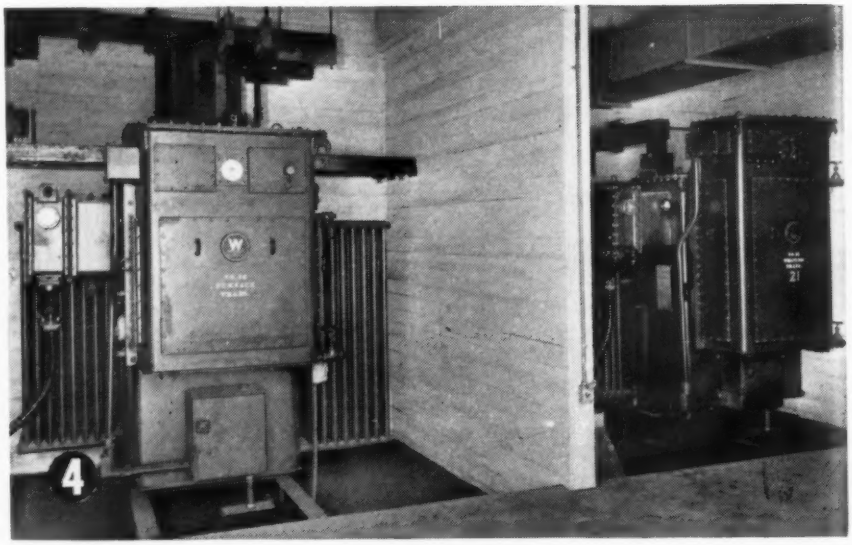
STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Baltimore Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

before purchasing Boiler or Fuel Burning Equipment

Water and Power for Magnesium Making (*Continued from page* 95)

electric current to drive compressors, pumps, cranes and other chlorine-plant equipment goes through this Westinghouse 2000-kva Inerteen-cooled 4160/460-v 3-phase transformer and its associated high- and low-voltage switchgear. Lighting takes 500 kva of the total; rest goes to power



4 Chlorine gas enters an electrically heated furnace which is charged with magnesium-oxide pellets and carbon briquettes. The resulting chemical reaction produces magnesium chloride, from which metallic magnesium is made by electrolysis. The 485-kva transformer shown at left heats the chlorination furnaces while the unit on the right preheats the cells where electrolysis occurs

5 Electronic rectification provides the continuous 24-hr flow of dc needed for the electrolytic cells, in which molten magnesium chloride is reduced to metallic magnesium. The Westinghouse Ignitron rectifiers shown are assembled in units of 12 tubes, each delivering 5000 amp at 365 v, dc. There are 20 of these units, a total of 100,000 amp, serving cells

6 Two types of transformers handle power supply for Ignitron rectifiers at Basic Magnesium. Westinghouse rectifier transformers, at either end, were installed to provide power to the rectifier units for conversion to 350 v, dc. The three auto-transformers in the center of the bank are equipped with automatic tap-changing and supply power to the rectifier transformers over a range of 2000 to 13,000 v

INVASION *and the* FINAL CHALLENGE

The idea that our national security some day would depend upon the successful invasion of continental Europe by our armed forces was inconceivable to the average American but a few short years ago. Yet, today our whole strength is assembled to that very action and for assuring a sound and permanent peace.

America became great without aggression . . . without tyranny. Our greatness has been achieved without destroying others . . . ours is a history of unprecedented industrial progress, of development of our own resources and reliance on our own efforts.

Aggression is foreign to American philosophy. Yet, today we find ourselves faced with the choice of destroying or being destroyed. Today we are confronted by the hard fact that the kind of peace which we all so fervently desire can be achieved only by crushing autocracy and by removing the causes of aggression.

We are now engaged in the accomplishment of the first objective. Since Pearl Harbor a complacent, peace-loving America—the largest of the "soft" and "decadent" democracies—has grown strong and tough. Out of the inherent virility of a free people we have moulded the mightiest force for invasion and attack that the world has ever seen.

We have reached our peak rates of war production. We are producing as much war equipment as all the rest of the world combined.

History will record our industrial mobilization as a phenomenal achievement.

The battle of production has been won!

The full might of our armed forces and those of our allies unleashed against the Axis war machine will bring eventual victory. Two and a half years of intensive preparation, backed by 168 years of growth as a free nation, has given us superiority over twenty years of painstaking preparation by the totalitarian and militaristic countries with their enslaved peoples.

Every American has contributed toward this powerful offensive. Our manufacturers and business leaders have exerted their fullest efforts. Our industries have mobilized their tremendous resources—tapped to the fullest degree their inventive and productive genius. The men and women in the factories, on the farms, and in the mills and mines have played a magnificent

part in the tremendous production program. Citizens all are making their contribution to the armed victory that lies ahead

We have demonstrated that a free people under a free enterprise economy can unite in a common purpose.

* * *

When the war is won, we shall be faced by our second objective . . . removing the causes of aggression. This is a social challenge. A challenge to those who would sacrifice our democratic way of life for personal gains or foreign ideologies.

The best insurance for the continuance of our democracy is a successful democracy. That means a dynamic and not a static democracy. All of us who want to preserve the ideals that have made America . . . and that includes all but a handful of extremists . . . must determine to find the policies and programs which will permit us to make the most of the abundance nature has provided for us.

To achieve this end we must recognize the fact that we are but a wheel in the machinery of world economy. A wheel that must drive or be driven. A wheel that must mesh smoothly with the many other wheels or be stripped of its cogs.

We are the only nation on earth free enough and strong enough to shape the mould of its own destiny. We can be hampered by nothing but our own confusion.

* * *

The mind and the heart of all America today brood over the shores of Britain and watch over the narrow waters that wash the beaches of the Continent. And the prayers of all America go with each of those who embark upon that epic passage.

Those of us at home who are producing the fighting tools and who are so earnestly concerned with the problems that will face a postwar America, should see now, even if we may never have seen it before, that all our plans will be worth just exactly what the men and women who make that passage are prepared, competent, and inspired by their leadership to make them worth.

For those men and women are America!

They have gone out from rich homes and poor homes alike, from farms and factories, from schools and churches, from mines and ranches, from offices and studios, to take their places in the battle line. They are a cross-section of the America that is to be.

Whoever may draw the plans for that America, it is those men and women who will make the plans good. Invasion is their first step toward that end. May their work be speedily done, and may our plans be worthy of that work.

President, McGraw-Hill Publishing Company, Inc.

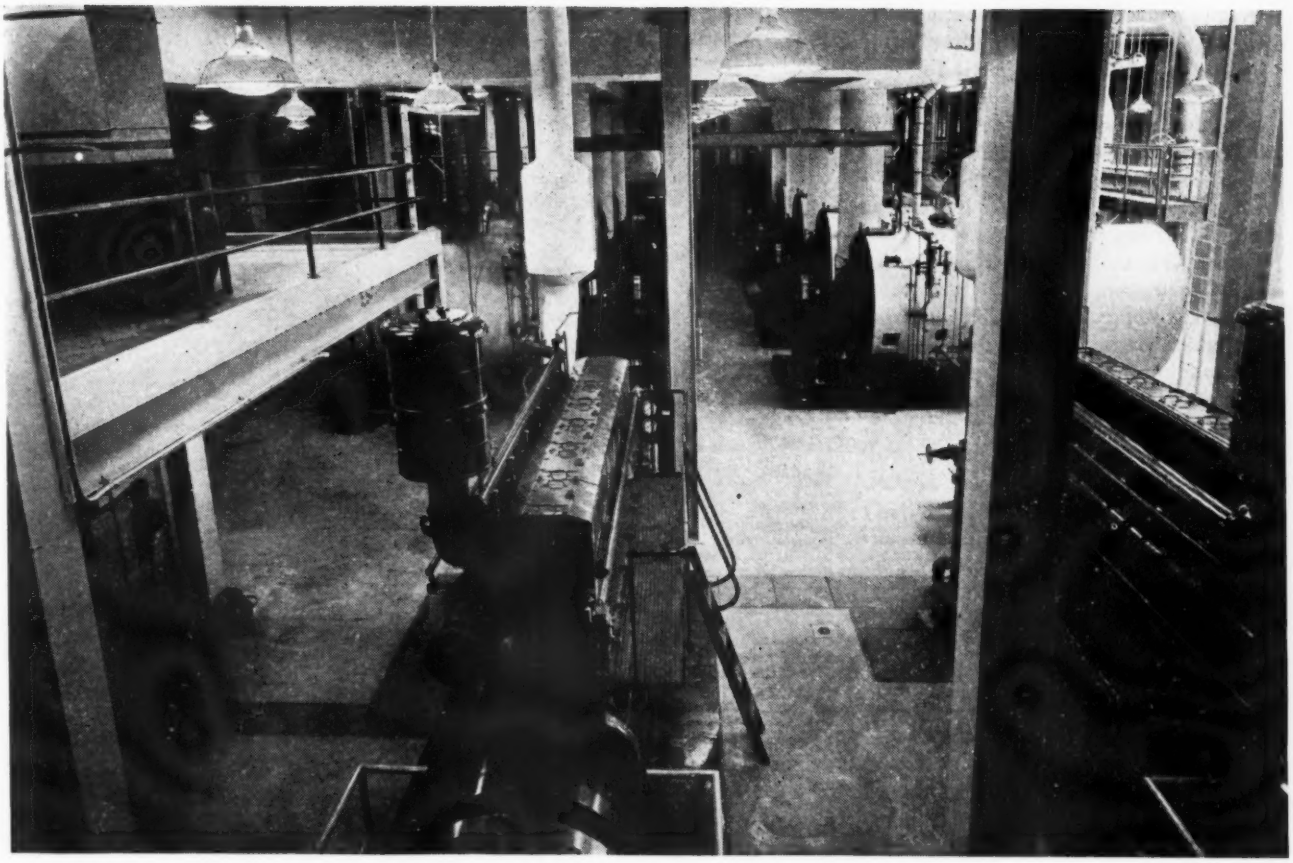


Fig. 1—General view: diesel generator units in foreground, "packaged" steam-generator units at the rear

Diesel-Steam Plant Solves Blackout-Factory Problem

Diesels insure emergency light to prevent possible panic; steam boilers supply normal heating and process

▶ BLACKOUT CONSTRUCTION employed in many of the new war-production plants introduces special power-service problems—any power-supply interruption means darkness and possible panic. In a recently built war plant somewhere in the East, an interesting diesel and steam plant provides additional safety by supplying part of the normal lighting load and all heating and process requirements. Main power supply comes from utility high lines at 33,000 v, which is stepped down to 4160 v in an outside transformer station. Approximately 800 kva of diesel generators augment this main power source and 120,000 lb per hr of boiler capacity supplies the steam load.

Diesel - generating and accessory equipment occupies one end of the rectangular plant area, Fig. 1. Generating equipment consists of three 7-cyl 10.75x 14.5-in. 450-rpm 400-hp Worthington 4-cycle diesels driving Westinghouse 271-kva 4160/2400-v alternators with direct-connected exciters. Pickering isochronous hydraulic-relay governors control engine speed for close frequency regulation; a Westinghouse Silverstat regulator holds voltage.

Electrical Connections

Generator output feeds to the main-plant bus structure, connecting to a section supplying emergency lighting circuits and a few power circuits that must not be interrupted. The diesels operate continuously and thus there is no time lost in "picking up" the emergency load when the main power supply goes out. Switching arrangements permit supplying utility power to that portion of the lighting circuits normally supplied by the diesel generator. A battery of Gould cells stands by to provide 125-v dc for control circuits in the event of power failure. Diesel-plant switchgear is General Electric dead-front metalclad equipment, consisting of six generator and four feeder cubicles.

Each of the three diesel engines has its own individual auxiliaries and normally operates as an independent unit, but piping interconnections permit interchangeable use of auxiliaries. In the closed cooling circuit, individual pumps circulate water through the engine jackets and through Ross shell-and-tube heat exchangers. Raw water comes to the heat exchangers from a 150,000-gal tank which supplies plant fire-protection requirements. Heated water returned from the diesel plant keeps the storage tank from freezing in winter. Bypasses around the heat exchangers, and temperature-regulating valves, hold outlet temperature to about 140 F; maximum temperature rise runs about 20 F. To permit engine operation before cooling-

water piping was completed, temporary connections were made from the drinking-water system to the jackets and then overboard. This setup, made permanent as a 2-in. line to a pressure reducer with branch lines to each engine, permits emergency cooling of engines.

Engines are fully pressure lubricated: A shaft-driven pump draws lube oil (Socony-Vacuum DTE) from the engine sump and pumps it through a Nugent strainer and Ross oil cooler to the main header which supplies main and crankpin bearings and piston pins. Branches from the main header supply camshaft drive gears, camshaft bearings, governor drive, valve gear, fulcrum-shaft bearings and cam rollers. Part of the lubricating oil continuously bypasses to a Cuno filter and a Luberfiner adsorbent unit. Under present conditions, operators change oil every 1000 hr of operation and add more between changes. Purification is used.

Diesel Fuel System

The No. 4 fuel burned in the diesels comes to the plant by rail or truck. Either of two 25,000-gal underground storage tanks can be filled from either source by gravity. Three Worthington gear pumps, with float-switch control, supply oil to three 150-gal day tanks mounted on the balcony. Fuel feeds by gravity through Nugent twin strainers to the engines. Each unit has its own transfer pump, day tank and strainer; piping layout permits interchangeable operation.

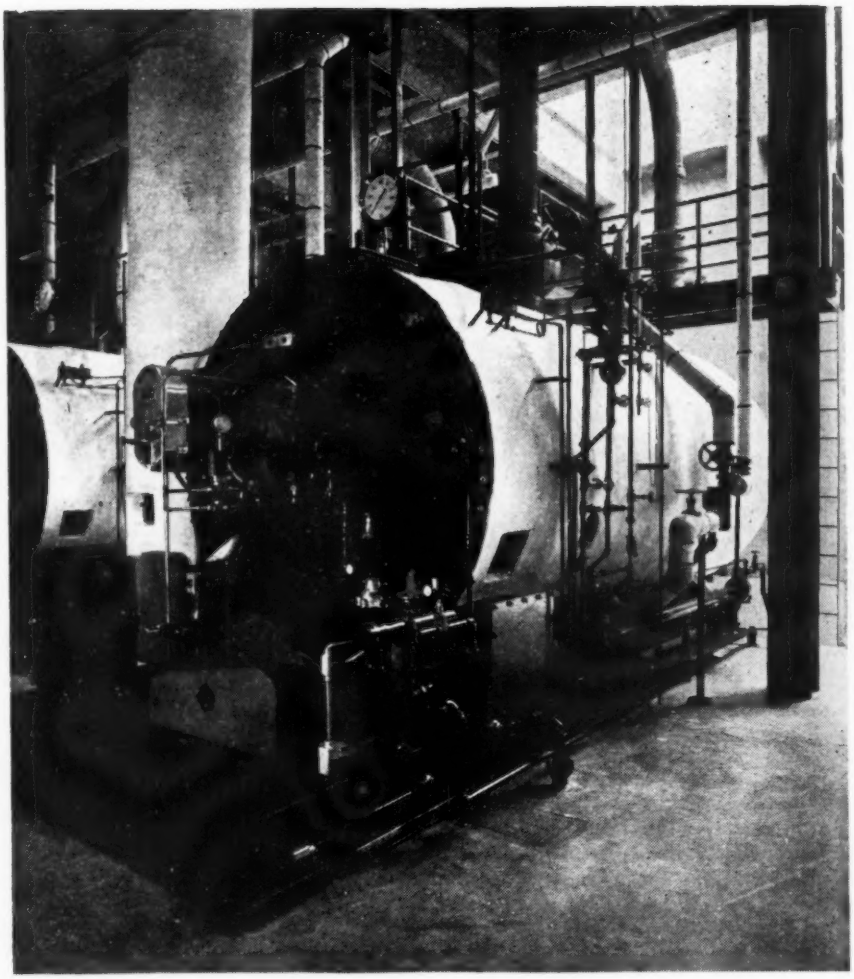


Fig. 3—Closeup of typical steam-generator unit, showing integral auxiliaries and control equipment. Boilers arrived at plant fully assembled

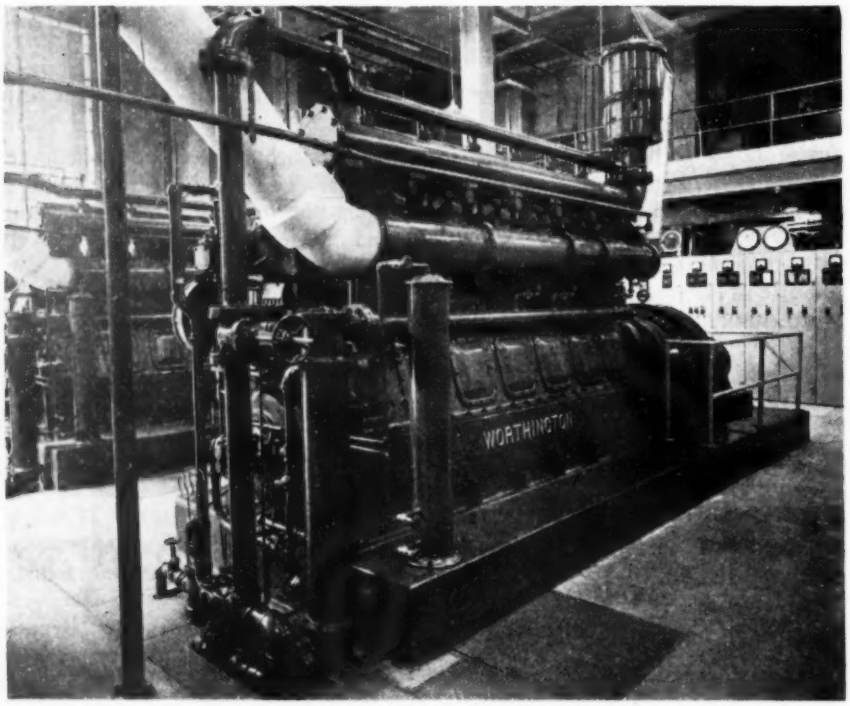


Fig. 2—Each 400-hp diesel, and its auxiliaries, is hooked up to operate as an independent unit, but interconnections permit interchangeable operation

Intake air, drawn from the engine room, passes through American oil-bath filters before entering the manifold. Exhaust gas enters Burgess snubbers and then goes to the exhaust stacks.

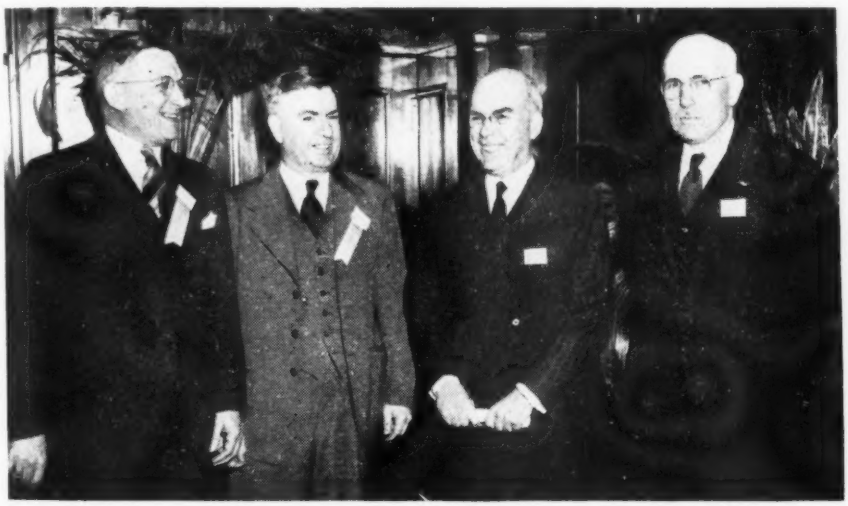
Starting-air equipment consists of two Worthington 2-stage compressors, one motor-driven, the other powered by a Wisconsin 4-cylinder gasoline engine. The former automatically holds pressure in the three starting-air tanks under the balcony; the latter permits starting up the plant without outside power.

Need for utmost reliability puts emphasis on sound operating and maintenance procedures. Normally, operators keep three engines on the line. Regular inspection and preventive maintenance keep engine-operating hours evenly distributed. In brief, operators follow this schedule: Indicate engines and check valve clearance weekly, clean and test injection nozzles every two weeks, remove crankcase handhole covers every 1000 hr to inspect crankcase

(*Continued on page* 142)

Mechanical Engineers Meet in the South

Nearly 500 mechanical engineers met in Birmingham, Ala., for a 3-day session to discuss problems and report progress in personnel training, aircraft production, power-plant operation and maintenance, heat transfer and pump development



J W Eshelman, vice-president; H G Mouat, local chairman; R M Gates, president; and J A Noyes, vice-president, get together between meetings to talk things over

▶ MAKE EVERY MINUTE COUNT. That was the keynote of the program for the ASME's spring meeting, held April 3 to 5, at the Tutwiler Hotel in Birmingham, Ala. Eleven different engineering subjects were covered by 37 speakers in 16 swift-moving sessions, with time out the second morning for a round-trip inspection of the plants of American Cast Iron Pipe Co, Rheem Mfg Co. and Bechtel-McCone-Parsons Corp. Here are highlights of several of the papers:

Steam and Hydro Operation G W Spaulding, Pennsylvania Water & Power Co, in his paper, "Coordinated Operation of Hydro and Steam Capacity," described interconnected operation of run-of-river hydroelectric plants with steam-electric stations. During the past two years this method of operation, together with intersystem ties, has saved considerable critical coal and fuel oil, which in turn has relieved the railroads of carrying this added burden.

Using the pondage at run-of-river hydro plants as part of the system reserves—such use being based on the probabilities of noncoincident maximum system loads, minimum river flows, and forced outage of steam capacity—assures fullest utilization of hydro and steam resources. The interconnection described by Mr Spaulding is in a highly diversified area of the Middle Atlantic States, served by 17 or more utility systems having a combined capacity of over 4½ million kw. Four companies in the southern part of this area coordinated their steam and hydro ten years ago while three units in the northern part began coordinated operations much earlier. Interconnection between the northern and southern systems began about 1931 and over-all coordination has subsequently developed with more recent tie-in with other systems in New York and the New England States. Originally initiated for economic reasons, the coordinated operation of interconnections in this region has been of vital help to the conduct of the war effort.

"Range of Operations of Steam Plants in a Combined Steam and Hydro System," by A T Hutchins and Howard Duryea, Commonwealth & Southern Corp, describes the many steam generators installed on this system.

(*Continued on page* 180)

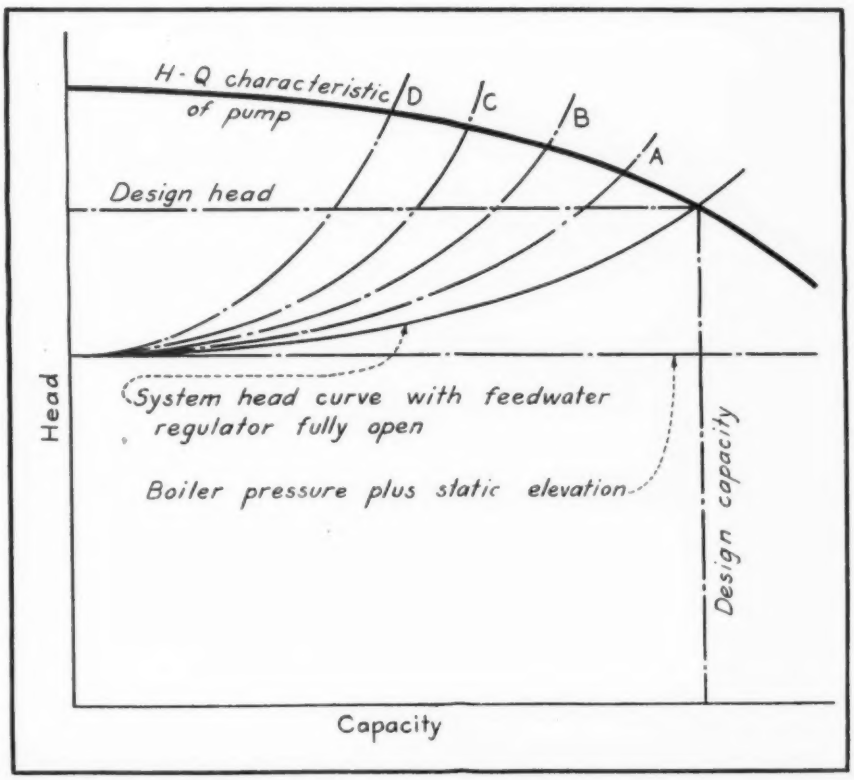


Fig. I—Feedwater regulator alters feed-pump operation by varying the system friction head. Curves *A* to *D* represent feedwater-regulating valve positions and pump discharge corresponds to intersection between these curves and H-Q curve

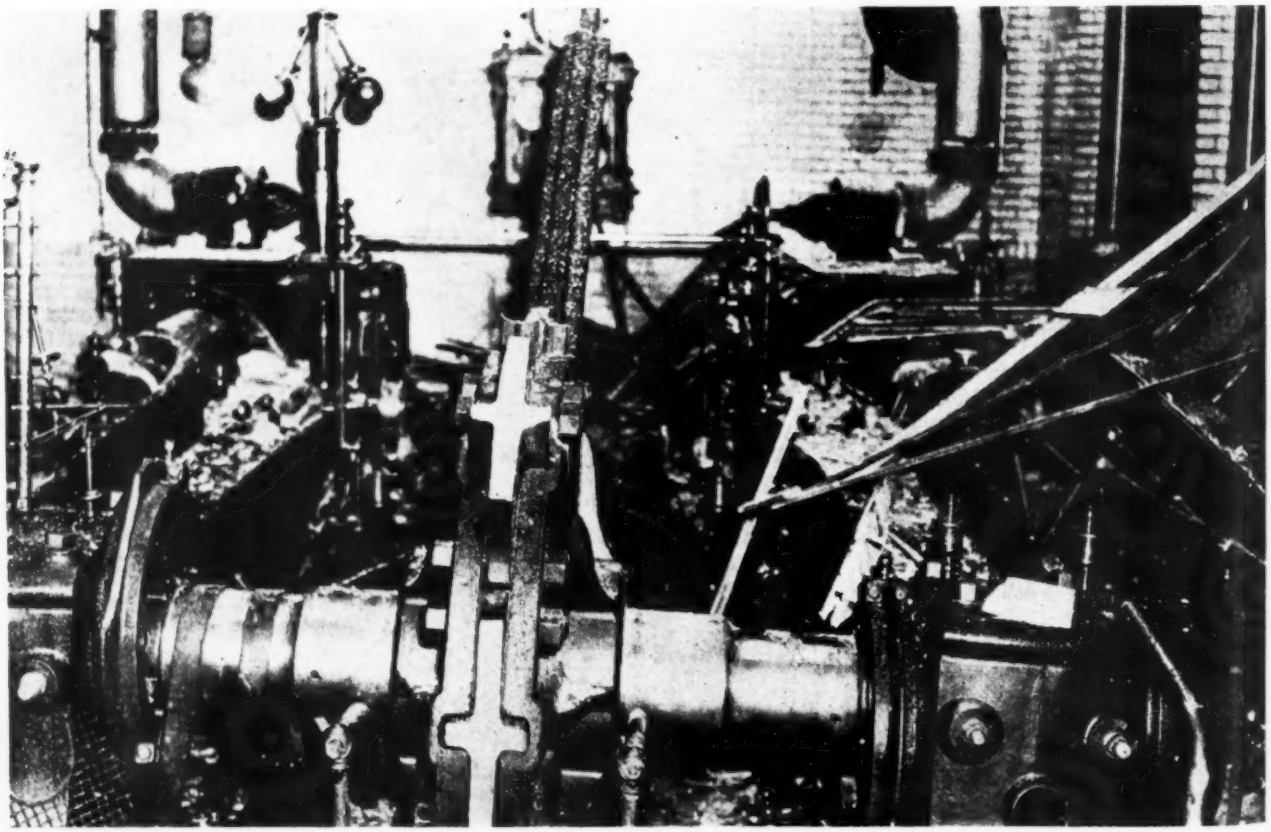
Idler Wrecks 50-Year-Old Steam Engine

▶ WHEN THE SHAFT BROKE in an idler, guiding a 42-in. belt 180 ft long, in the Talbot Mills, North Billerica, Mass., the idler fell and wedged between the rim of a 22-ft flywheel and the wheel pit of a 52-year old corliss twin engine. Both wheel and engine were wrecked and considerable other damage was done. One spoke with a section of the flywheel rim was thrown 100 ft and landed on an upper floor (right) while the engine itself (below) suffered heavily. Examination showed the governor had not failed, nor had overspeed occurred. Because of a change in shifts, only one man received minor injuries.

Lowell Electric Light Corp rushed new power connections so that major departments in the mill operated in a day and a half after the accident. A 300-kw generator previously belt driven from the main mill shaft served as a synchronous motor, two small water wheels bringing it up to speed when tying into the utility system.

Above—One spoke of the flywheel with a section of its rim was thrown about 100 ft in the air and came down, spoke first, into the top floor of the building

Below—This is what happened to a twin corliss engine when an idler pulley fell and wedged between the rim of its 22-ft flywheel and the side of the wheel pit



THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS • MAINTENANCE HINTS • QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Can You Use A Less Critical Coal?

Next winter's estimated 20-million-ton coal shortage can be cancelled by consuming 5% less. H F Eastwood, Anthracite Industries, Inc, offers a solution in describing how one plant mixes coal-yard screenings with slack bituminous

COAL IS TIGHT. Next winter it will be tighter. So from now on, save at least 5% of your plant's fuel. If you go the limit and save even more, every additional ton saved helps the other engineer who cannot reach the 5% quota. Have you exhausted every possibility? You help cut fuel use by putting all steam equipment into first-class condition—improving turbine or engine-water rate, cleaning heat exchangers, repairing traps, repacking valve stems, checking boiler baffles and cleaning boilers inside and out. But what about the coal pile itself? Can you change to a less critical coal or mix it with your present fuel?

Fine anthracite, a byproduct of sizing operations at the mines offers one means of reducing consumption of other coals. Local yards serving the domestic market are another source of these fines or screenings left as residue from handling the larger grades. Mixing this coal with bituminous may in some cases offer the added attraction of reducing fuel costs.

Experience Speaks

A remarkably fine record has been made in using an anthracite bituminous coal mixture during the past twelve years in the power plant of the Long Island College Hospital, Brooklyn, N. Y., under the supervision of H Carlsen, chief engineer. Here is a short description of this plant.

Boiler-room equipment consists of three 2575-sq-ft 250-hp Union Iron

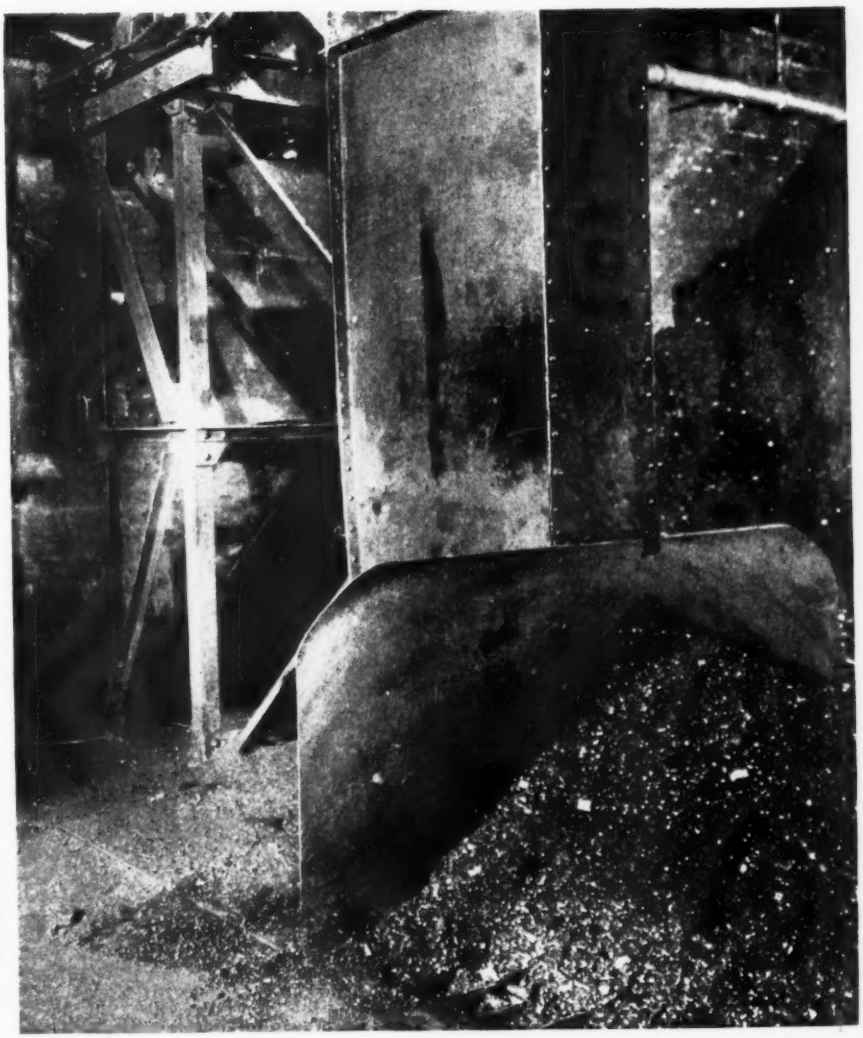


Fig. 1—Stored at opposite sides of main bunker, bituminous coal and screenings are hauled alternately, dumped into an elevator that carries coal to scales

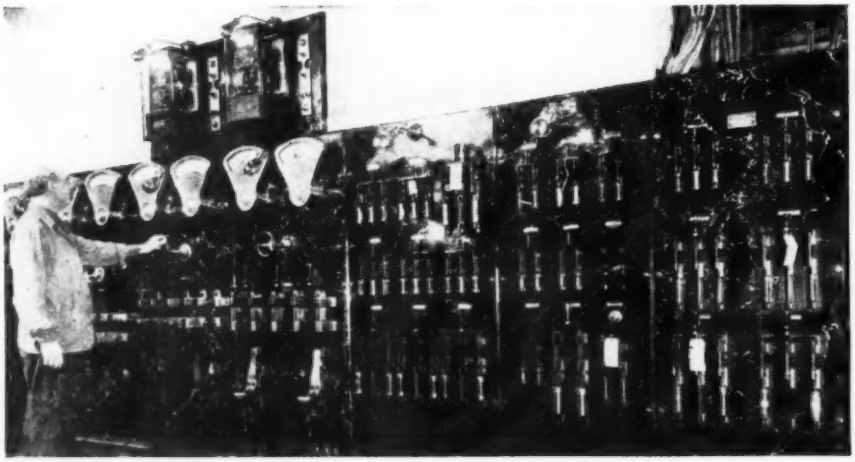


Fig. 2—Three 3-wire dc generators feed this main switchboard that distributes power to all sections of hospital. One generator normally carries entire load

COAL ANALYSIS: BITUMINOUS

Volatile matter	24.3%
Fixed carbon	67.8%
Ash	7.9%
Moisture	3.1%
Sulphur	1.1%
Heat value (as received)	13,874 Btu
Heat value (dry)	14,322 Btu
Ash-fusion temp.	2714 F

Works longitudinal-drum horizontal watertube boilers; three Flynn & Emrich Huber automatic overfeed stokers, each 7 ft wide and 7½ ft deep with a total active grate area of 52 sq ft. A Ruggles Klingmann step-action master regulator simultaneously controls coal feed and natural-draft intensity by connection to uptake damper. Bailey steam meters, CO_2 recorders and Richardson coal-weighing equipment provide a continuous picture of output and general efficiencies.

Steam for Power

The boilers generate steam at 125 psi for engine-driven generators, a refrigerating compressor, and the hospital laundry. Engine exhaust at 4 psi heats the hospital and domestic-water supply. Steam reduced to 60 psi serves the kitchens and hospital sterilizers; underground lines, operating at this pressure, feed several housing groups used for nurses' quarters where it is reduced to 3 psi at each individual house. A vacuum system returns all condensate to the boiler room.

Electrical-generating equipment consists of a 300-kw 400-rpm 125/250-v 3-wire vertical uniflow-engine, a 150-kw 200-rpm 125/250-v 3-wire horizontal uniflow engine, and a 75-kw 275-rpm 125/250-v 3-wire slide-valve engine-driven generator. Another slide-valve engine drives a 15-ton CO_2 refrigerating compressor. By the way, the engineer saves ¾ ton of coal per day by driving this compressor with an electric motor in summer when exhaust steam is not needed for heating. He removes the engine connecting rod, disconnects the valve eccentric and drives the unit with a belt from its flywheel to the motor pulley.

Engineer Carlsen uses a 50-50 mixture of run-of-mine or nut-slack bituminous and anthracite barley or yard screenings. Bituminous comes in 350-ton lots and is stored in a bunker adjacent to the boiler room, Fig 1. Anthracite screenings trucked daily from local yards go into a pile at one end of this bunker. To provide thorough mixing, (1) wheelbarrow loads from alternate piles are dumped into a bucket elevator that (2) hoists the coal to a Richardson scale where (3) it is weighed and (4) dumped into a screw conveyor, which carries it to stoker hoppers.

A strong coking bituminous coal is preferred for mixing with anthracite on this type of stoker because it incloses small sizes of the latter into the coke structure on a coking shelf just after the coal enters the furnace. This prevents a high percentage of riddlings sifting through moving grates into the windbox. To obtain best operating results the combined fuels should develop a coke structure that can be broken by the stoker action. Only time the fireman has to rake the fire is when he levels it off after cleaning and dumping the ashes once every four hours. Movement of the sloping stepped grate is timed to develop a fuel bed giving best furnace performance, as indicated by a 24-hr average CO_2 ranging between 10 and 12%.

Average Steam Cost

Engine-room log shows that between 1932 and 1943 average cost of steam per thousand pounds during January was 21.9 cents. Costs increased 03.7 cents between 1932 and 1943; average for 1943 was 23.8 cents and for the first three months of 1944 it rose to 29.7—all accounted for by increased fuel cost as the evaporation rate did not show a

(*Continued on page* 104)

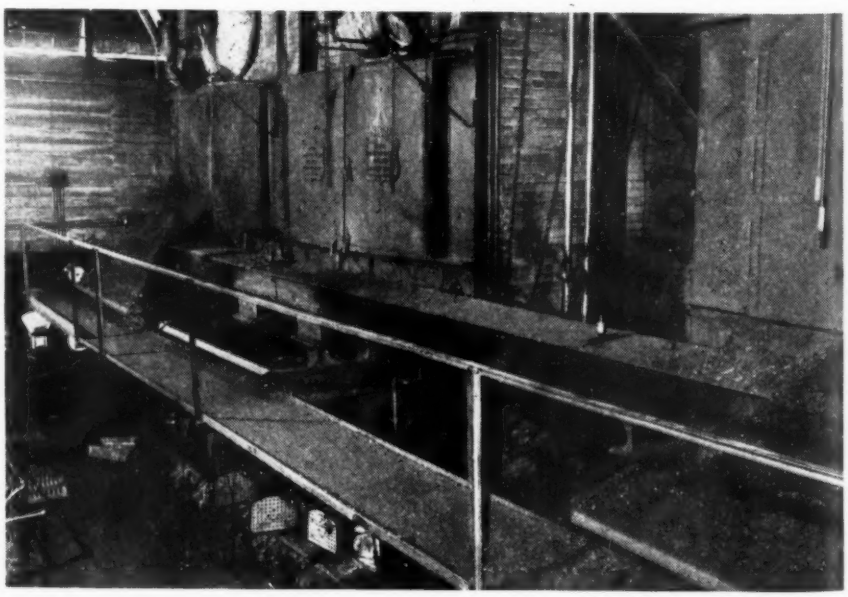


Fig. 3—After being weighed, the coal passes to a screw conveyor that transports it to stokers. Conveying system operates intermittently to fill hoppers

Two Large SILENT-CHAIN DRIVES *In the Space Width of One Coupling*

J D Walsh, district engineer, Link-Belt Co, tells how a plant, when purchasing power because of increased load, removed the coupling between a compressor and its dc motor and in this space installed two silent-chain drives to separate motors

EARLY IN THE WAR EMERGENCY, R E Funsten Co, shelled-pecan dealers, St. Louis, Mo., faced the problem of quickly revamping their old and overloaded boilers that supplied steam for heating and power generation. Because of priorities a new boiler was out of the question and so they decided to buy part of their required electric power supply.

A study showed that an ice-machine compressor was the load section that could be most conveniently transferred to purchased power. This compressor was directly driven by a dc motor that formerly served as a generator. The engineers arranged to convert this motor to a generator again and drive it by a 125-hp 690-rpm slipring motor, also, to drive the compressor by a 75-hp 690-rpm slipring motor—both motors to be operated on purchased power.

Because the dc motor, to be converted to a dc generator, was coupled directly to the ice-machine compressor, the ends of their shafts were in line and quite close together. To move the machines farther apart would have been expensive and space in the compressor room was at a premium. This presented the problem of getting a 75-hp drive for the compressor and a 125-hp one for the generator, within a width of 18 in. and with sufficient clearance between the two.

Two silent-chain drives provided the answer. The engineers removed the coupling halves from the motor and compressor shafts. They replaced the coupling half on the compressor shaft with an 81-tooth silent-chain drive wheel and on the dc-motor shaft put a 58-tooth drive wheel.

Motor-and-Chain Drives

As shown in Fig. 1, the 75-hp slipring motor, *M*, was placed directly back of the compressor's flywheels. This motor has a 23-tooth pinion on its shaft that connects to the compressor drive wheel by a 1¼x8-in. middle-guide silent chain operating on 5-ft, 6-in. centers. This motor drives the compressor at 197 rpm.

Also in Fig. 1 the 125-hp slipring motor, M_1, can be seen directly back of the dc motor converted to a generator. This motor also has a 23-tooth pinion on its shaft connected to the generator's drive wheel by a 1¼x8-in. silent chain operating on 5-ft, 6-in. centers. This drive operates the generator at 271 rpm to produce the desired voltage for the plant's dc-power system.

The two drives run with less than one-inch clearance between them, and operation is highly satisfactory. Both operate in the same oil retaining casing, with complete oil-pump automatic lubrication. A side view of these drives is shown in Fig. 2. The motor-driven oil pump at *P*, mounted on the casing side insures automatic oil-bath lubrication for both chains. In the right foreground is the 125-hp motor, M_1, that drives the dc generator on the right. Note directly back of them the compressor flywheels and motor, *M* that drives the compressor, both motors being directly in line.

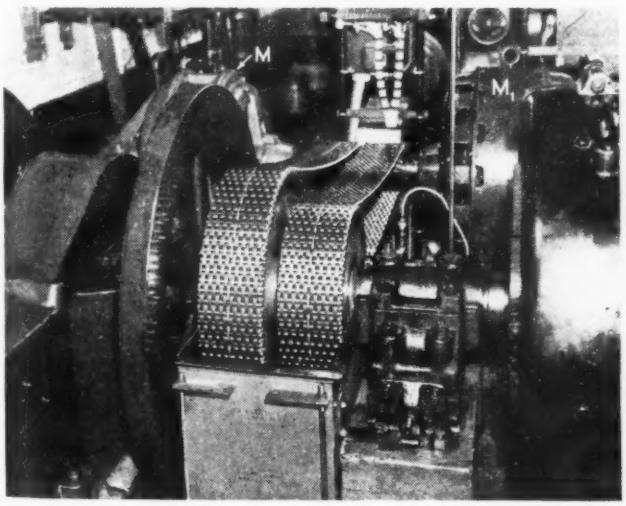


Fig. 1—The 75-hp 690-rpm slipring motor, *M*, drives the compressor through the silent-chain drive on left and the 125-hp 690-rpm slipring motor, M_1, drives the dc generator through the silent-chain drive on right. The two chains go in the space width originally occupied by a coupling

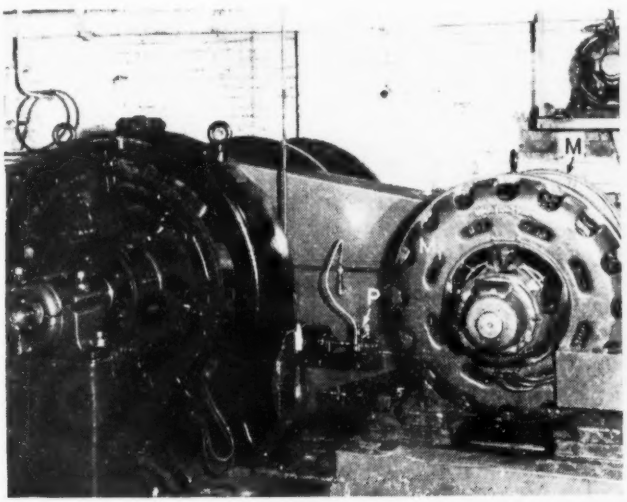
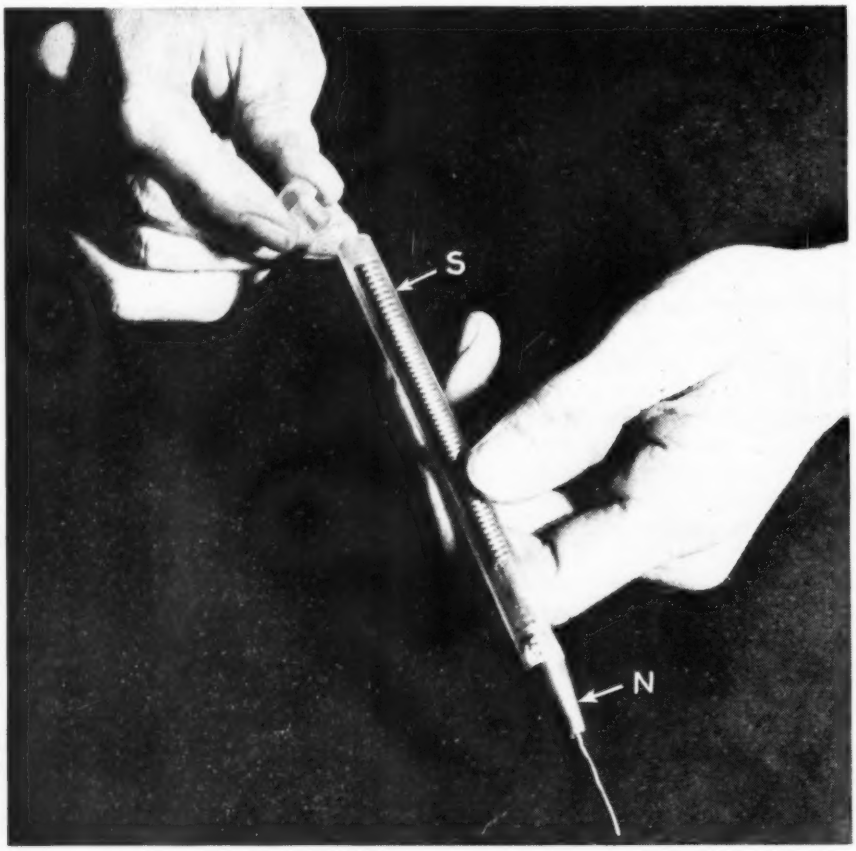


Fig. 2—Casing between the two motors, *M* and M_1, and the dc generator and compressor on left incloses two silent-chain drives that connect the motors to their respective loads. Motor-driven oil pump, *P*, on side of the silent chain inclosing casing insures automatic oil-bath lubrication

PRACTICAL AIDS TO OPERATION



Handy Dispenser Saves Solder

THE PENCIL SOLDER DISPENSER in the photo was devised at General Electric's Schenectady Works. It prevents wasting solder, as well as its contamination from handling and dirt. The dispenser was made from a piece of methyl-methacrylate-resin tubing. Brass nozzle *N* is cemented into the tubing end with a press fit. Before loading the solder into the dispenser, it is form wound on a small drill rod in a bench lathe. A sufficiently long straight end is left on the solder so that when the coil is pushed into the dispenser the straight end projects out through the nozzle. After that, the operator pulls the solder out through the nozzle with pliers as it is needed. The open end of the dispenser is closed by a tight-fitting plug after loading with solder.

Relief Valve Permits Air to Enter Pump

ONE OF OUR DEPARTMENTS uses filtered city water and softened mill water, to make a blended water. It is fed to an open storage tank and the piping is arranged so that a large supply of this water is available for filling machines quickly. Some of this blended water was required by another department higher up in our building so we had to find some method of delivering it.

We had a small pneumatic-system pump which we installed with a 200-gal tank. However, we had difficulty with the pump. We could not get air through the air-intake valve and the pump operated erratically. Pressure on the pump suction line amounted to 6 to 10 lb, which apparently prevented the pump valves closing properly.

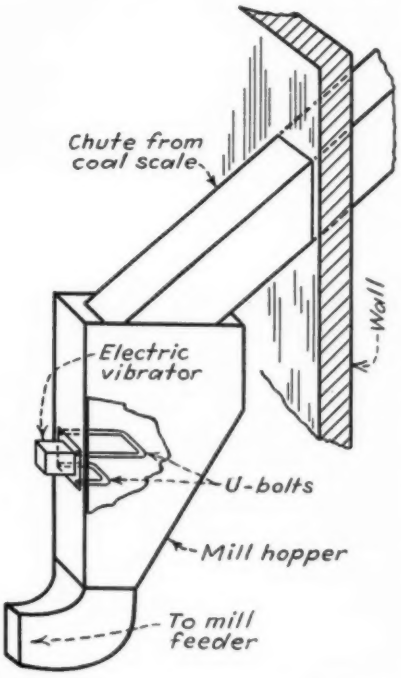
To overcome this difficulty we took out the original spring from an old adjustable relief valve and made a lighter one. We installed the valve with its new spring in the suction line in place of an elbow, about 15 ft from the pump.

This valve was installed so that water coming into the pump through the suction line had to lift the valve off its seat. This made the pump reduce the pressure enough in the suction line, back to the valve, to create sufficient differential across the valve to open it. We adjusted the valve spring so that the pump reduced the suction-line pressure to where air could enter when the relief valve opened to supply water to the pump. This simple arrangement solved our problem and has worked satisfactorily without attention.

WILLIAM T ESTLICK
Ansonia, Conn.

Improves Coal Feed To Pulverizer

EVEN THOUGH our pulverized-coal mill hopper was equipped with an electric vibrator, there was difficulty getting the coal to flow freely to the mill. When the coal was wet it was necessary to punch it almost continuously to keep the mill from running empty. To remedy this trouble we altered the electric vibrator mounting. As indicated in the figure, the vibrator mounting bolts were removed and replaced with U-bolts. The U's extended part way into the mill hopper, and transmitted the vibration into the coal.



Even though the change has not com-

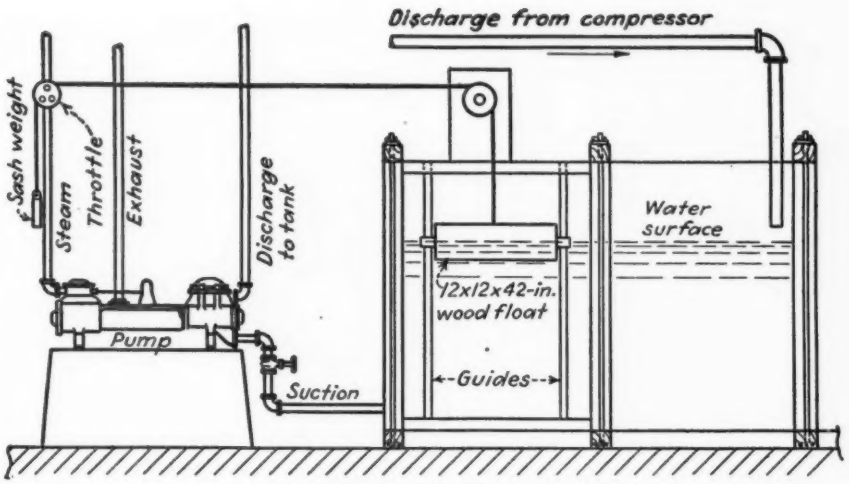
pletely eliminated the necessity for punching the coal, it has greatly reduced the amount required.

Staunton, Va. B G SWITZER

Float Regulates Pump Speed

COOLING WATER from the cylinder jackets and intercoolers of our air compressors discharges into a tank in the engine-room basement. A steam pump returns this water to the main supply water tank where it cools and is reused. Thus, the only water lost is from evaporation—a comparatively small amount.

To adjust the steam throttle valve, so that the pump removed water from the tank as fast as it flowed in, proved impossible. The tank would either overflow or go dry. To eliminate this difficulty I built and installed the float-operated control shown in the diagram.



The float, made of a 12x12x42-in. wood block, covered with a good coat of water-resisting paint, connects to the throttle valve by a sash cord. This cord makes one turn around a 3-in. sheave on the valve stem and its free end connects to a 5-lb sash weight. Two pieces of ¾-in. pipe serve as guides for the float. Their top and bottom ends are in wooden supports and the float connects to each by a staple driven into the wood, of a size to run freely on the guides.

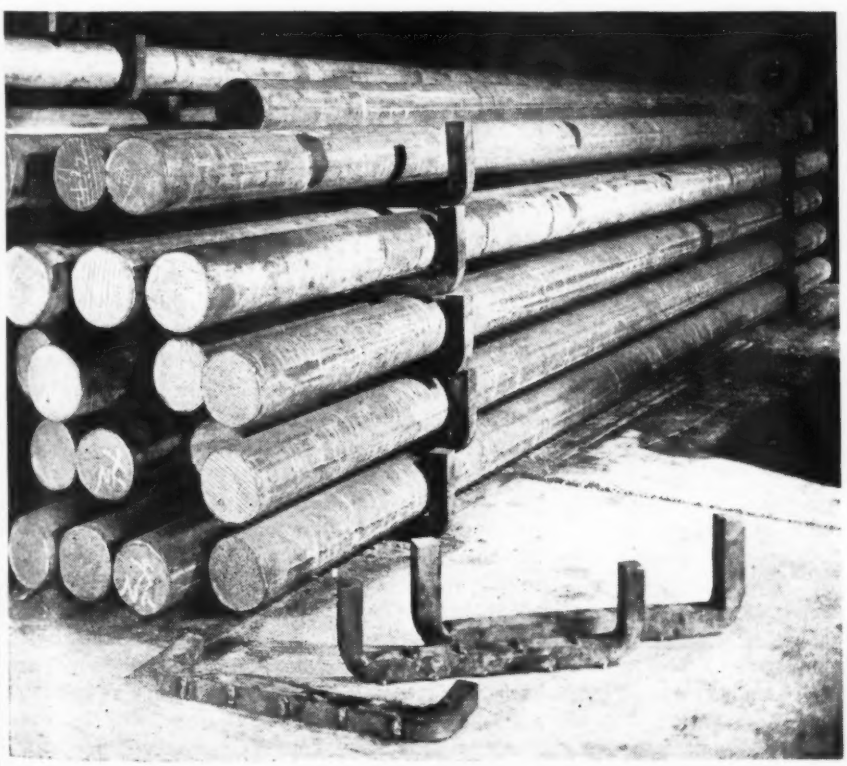
With this device, the float positions the throttle so that the pump removes the water from the tank about as fast as it flows in. Slight variations from this position are corrected by small movement of the float to adjust the throttle to control pump speed.

Seattle, Wash. C O HAGEN

Cradles Store Round Material

ROLLED, ROUND STOCK is stored quickly and neatly with cradle supports shown in the photo. Used by Westinghouse Electric & Mfg Co, they are made of 1x¼in. bar steel of a size to accommodate different-diameter rolled stock. Ridges welded on the top side of the cradles prevent the round bars from rolling in them, and on their bottom sides prevent the cradles rolling on the bars.

These cradles can be moved from one place to another, wherever needed. In spite of their mobility, they hold rod stock securely. Even though these cradles were primarily made for holding round steel rods, they can be used for storing pipe or other round material.



Centrifugal Pumps Repaired With Solder

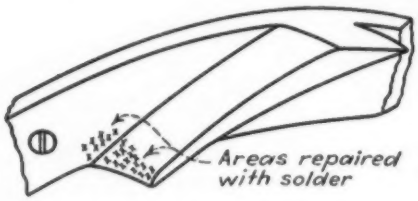
WE FIND that ordinary tin-lead solders make effective repairs on bronze diffusion-ring tips, face rings and impellers on centrifugal pumps where these parts have been worn by cavitation. Our experience shows that such repairs resist the washing action of water better than bronze. This is probably because of the closer graining of solder. Our experience has been confined to fresh-water and sewage pumps at temperatures below 100 F. Here are examples of such repairs:

The impeller of a single-stage 24-in. volute pump began to float within the limits of its thrust bearing and although equipped with flexible coupling, transmitted a bump to the motor bearings. When we removed the pump-casing top we found that several small copper plugs in the impeller side had loosened and dropped out, leaving several ½-in. holes.

These were sufficient to cause impeller oscillations in a direction parallel to the shaft. We decided to solder these holes and brushed their surfaces with

killed muriatic acid and held a piece of asbestos board back of them. Solder was applied by holding the soldering iron (A 5-lb pair is about right for this work) against the impeller side and feeding solder as it melts into the hole. It is not necessary for the solder to flow in the usual sense as the holes are washed out, leaving many small keying places. The solder can be more or less plastic and pushed into place by an iron just hot enough to permit working the metal into the cavity. Practice and patience give good results.

Another example was that of face rings in a pump casing that wore near where the diffusion vanes ended. We filled the worn areas with solder by the method described. After filling, the surface was leveled by careful filing, and checked by means of a straight edge.



All jobs are built up with an excess of solder and filed to a level surface.

These jobs were the most difficult because they were done on vertical surfaces. Repairs to diffusion tips, as in the figure, can usually be done more easily as these parts can be removed from the casing and placed in a favorable working position.

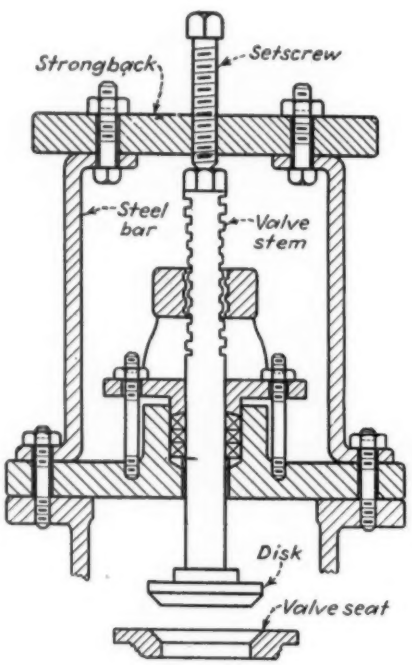
We have placed as much as 5 lb of solder on vanes and sides of impeller where necessary and they have given good service. Perhaps we were lucky but the solder did not cause any appreciable vibration due to mechanical unbalance.

This solder repair was originated by Samuel Hetherington, superintendent, Pumping and Filtration, Hamilton, Ont., about twenty years ago and has been employed by us many times with highly satisfactory results.

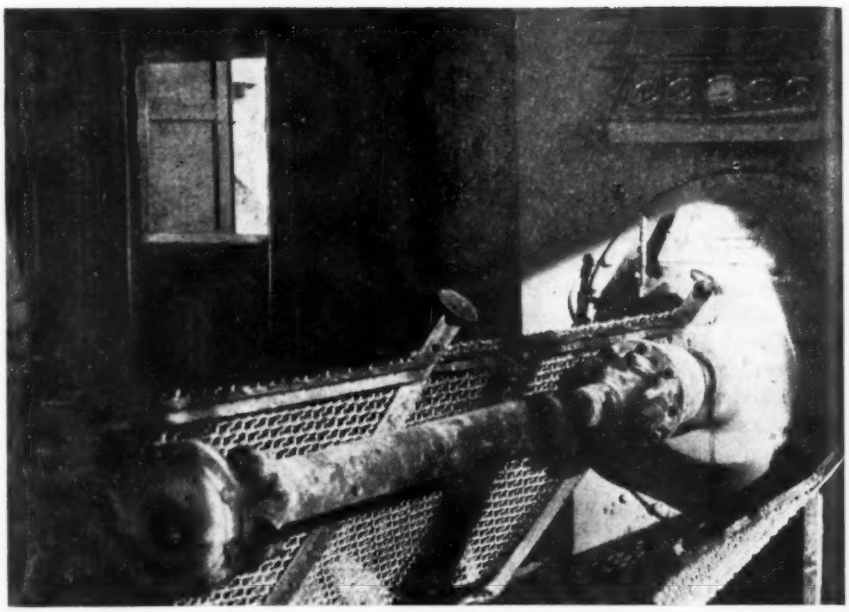
Hamilton, Ont. J A CAULDEN

Closes Valve When Stem Thread Strips

THREAD STRIPPED on a 4-in. valve stem and pressure under the valve disk held it open. To close the valve we bent two pieces of ⅜-in. steel bar and drilled holes in their ends, as in the diagram. We then removed two of the bonnet studs, one at a time, and attached the bars to the bonnet. Across the top ends of the bars we bolted a ½-in. steel strongback with a ⅜-in. threaded hole in its center. Then by screwing down a ⅜-in. setcrew in the strongback, we closed the valve. This makeshift closed and opened the valve until we could take the line out of service and renew the worn parts.



Great Neck, N. Y. S M ELONKA



Truck Shaft Solves Alignment Problem

ONE PLANT had trouble keeping a large gasoline engine in alignment with the right-angle gear on a deep-well pump. This problem was solved by locating the engine away from the pump and connecting the two by a drive shaft with needle-bearing universal joints taken from a discarded heavy-duty truck.

This shaft connects to the clutch shaft of the engine the same as it did in the truck. At the pump gear, the drive shaft connects the same as to the drive pinion in the rear axle of the truck. This arrangement permitted the installation to be made without expert supervision that would be required if the engine were coupled directly to the pump drive gear.

J C ALBRIGHT
Santa Monica, Calif.

The Old Gentleman Knew He Had Trouble

One busy morning a long distance call came through about as follows:

"I am Mr X, treasurer of the X Knitting Co at Xville. We are having some trouble with our generator and want you to send a man to fix it."

"What is the trouble?"

"Well, I really don't know."

"What is the rating of your machine?"

"I don't know that either."

"Is it ac or dc?"

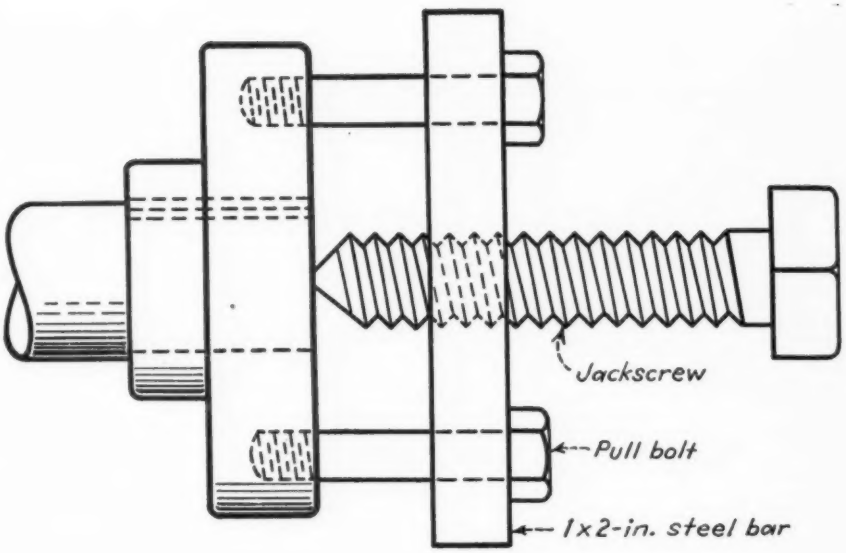
"I never bother with any of those details. We bought the generator from you some years ago, and you ought to know what it is! We are having trouble, and I want a man immediately!" Then he hung up.

One of the old timers was available, so I said, "Joe, go up to Xville and see what ails the old gentleman's generator."

Joe's report was: "The generator is an Edison bipolar, belted to a lineshaft and is so old it has sight-feed oil cups on the bearings. The operator forgot to fill the oil cups and the babbit in the pulley end bearings melted. They had a forge and a ladle so I rebabbitted the bearing and came home."

It was the only generator Mr X had ever bought, and as far as he was concerned, the only one we had ever sold.

Schenectady, N. Y. N L Rea
Service Engineering Div
General Electric Co



Pull Bar Removes Tight Couplings

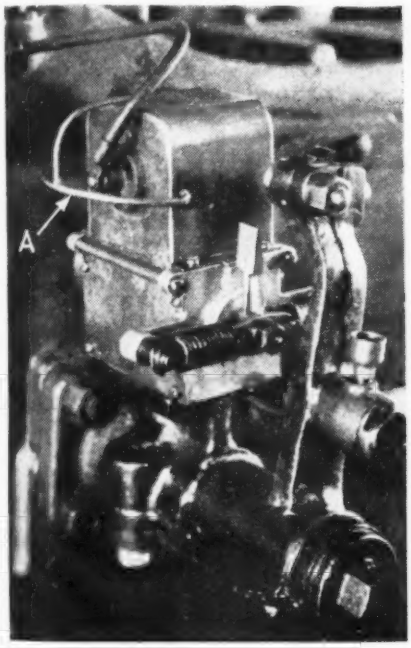
Having experienced a lot of trouble and delay by machines trying to remove flexible couplings from shaft ends and still have the coupling in usable condition, I devised the puller in the diagram. Coupling flanges that do not have through pinholes must be drilled and tapped, as indicated for two tap bolts. If holes are through the flange then the pull bolts may be put through them and nut used to take the pull on the coupling.

The pull bar, made of a piece of 1x2-in. steel, has clearance holes near its end for the pull bolts and a tapped hole in its center for the jackscrew. Normally a small amount of heating on the coupling makes the pull fairly easy.

On couplings difficult to remove, we bore a hole lengthwise through the key with a drill of a diameter about one half the size of the key. Then with a small copper tube we flow water through the key when it is on the top side of the shaft. With water flowing through the key, we quickly heat the hub with a large tip on an acetylene torch until the coupling starts under force of the puller.

During the entire pull, we apply heat to the hub and keep water flowing through the key. While we turn the jackscrew with one wrench, we hold the hub from turning with another wrench on the pull bar. It is necessary to circulate only a small amount of water through the key.

Mexico, Mo. F Heckman



Magneto Guards Reduce Maintenance Costs

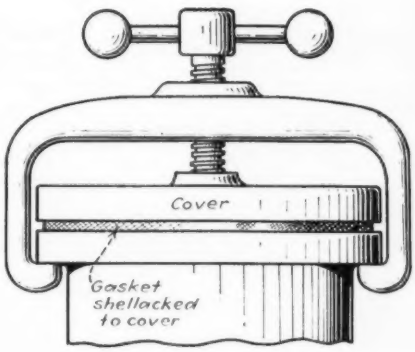
A large company that operates several slow-speed single-cylinder pumping engines noted that in many magnetos taken to the shops for repair or exchange, the fiber plug that supports the engine-spark-plug wire connection was damaged. Oil and moisture worked into crack in the fiber plug and in a short time caused a short circuit and ignition trouble which meant removal of the magneto for repairs.

It was found that the maintenance men damaged the fiber insulator when handling the magneto between the time of over-hauling and installation. A company mechanic solved this problem by brazing short curved pieces of brass rod to the body of each magneto to form a guard, as at *A* in the photo. Following installation of this guard on all magnetos, maintenance jobs decreased sharply.

Pomona, Calif. G M Wilson

Shellac Prevents Damage to Gasket

On a strainer that we opened frequently we had trouble from damage to the gasket. We shellacked the gasket to the cover, as in the diagram, and now when the cover is removed, the gasket adheres to it and is held where it cannot be easily damaged. This little kink also saves time when replacing the cover because the gasket is always in line with the bolt holes, and we have to clean only the strainer flange surface and one side of the gasket. Since we started shellacking the gaskets to the strainer-cover flange, we have used only a small fraction of the gaskets that we formerly did.



Great Neck, N. Y. S M Elonka

READERS' PROBLEMS

Questions From Our Readers

Question 1

What Causes Unequal Water Level?

WE HAVE EXPERIENCED trouble for some time from low water in the middle drum of our 3-drum 8000-hp boilers.

Generally the left drum shows the highest level, the right drum a somewhat lower level and the middle drum frequently shows no water at normal ratings. Boilers are pulverized-coal fired through a single burner located 5-in. to the left of middle-drum center line. Furnace contains water-walls.

We are anxious to equalize water levels and are considering (1) installation of double burners at center lines between drums or (2) changes to circulating pipes or tubes as may be necessary.

Perhaps other readers who have had similar trouble will give us suggestions or sketches of proposed corrections.—*ANL*

Question 2

Why Do Water Lines Contain Air?

HOT WATER for our 13-story apartment house goes from the basement heater directly to the 13th floor. From here the supply line drops down, feeding lateral branches that serve each floor.

We have considerable trouble from air or steam pockets on the 12th and 13th floors. Tenants complain that the line sputters with intermittent discharge of water when faucets or showers are first turned on.

Can POWER readers tell me what is causing this condition and what changes I should make in the piping system?—*HNF*

SUITABLE ANSWERS from readers will be paid for if space is available for publication. Answers that are accompanied by rough drawings or photographs will command additional pay.

Answers to March Question 1

What Causes This Water Hammer?

Our boilers generate steam at 70 psi. Steam is reduced to 5 psi for heating the hospital buildings which are separated over a fairly large area. Condensate flows by gravity to a low point on the system, from where it is pumped back to the boiler room.

We are troubled with a terrific amount of water hammer in the heating system. What are some probable causes of this condition, and what can we do to put the system in good operating condition?—WH

May Be Carryover From Boilers

HAMMER IS MOST LIKELY caused by appreciable amounts of water. For example, if it collects in the bottom of a vertical riser, steam flows uninterruptedly until it reaches this pocket. Here the steam, having greater momentum, forces the water aside and continues on its way. The water, on the other hand, is slammed against the pipe wall with a loud bang but, having the greatest density, is not carried along with the steam. It is continually slammed back and forth as steam passes.

If the boiler is functioning poorly, some water may be entrained with the steam and carried over into the heating system. However, condensation seems to be the cause here. Improper drainage and poor insulation on the steam lines causes water to form and be carried into the system. Lines should slope in the direction of flow and have enough slope to give proper drainage.

New York, N. Y. RUSSELL HENN

Lists Four Causes

WH's HAMMER could be caused by: (1) Over-cautious selection of traps, which resulted in buying them too large for the condensate they are handling. If traps are too large they are noisy and cause water hammer. (2) Traps might not be functioning properly, or valves might have loose parts, causing shock pressures that appear as water hammer. (3) Excessive condensation in the steam distribution lines to the various buildings results in slugs of water passing through valves or constricted passages. (4) Boiler carryover or excessive condensation between boilers and pressure-reducing valve might cause hammer at the valve.

In tracking down the trouble, WH must consider three things he did not mention: (a) How long has water hammer existed? If it has just occurred, the second cause is less likely than the others. If it originated lately, second or fourth are most likely. (b) What is the relation between intensity of water hammer and load on system? If hammer is worse at higher load, second and fourth causes are suggested. If it is worse at periods of lower load, first and third causes seem likely. (c) Is hammer of equal severity in all parts of system, or is it worse in some buildings? If it affects all buildings equally, first and third causes bear looking into. If it is noticeably worse in some, second and third are suggested.

If answers to the above three questions point to the first cause, this can easily be checked by weighing the condensate passing through each trap at full load, and comparing this with manufacturers recommendations. If answers point to the second cause, remove the traps and check their operation.

If tests point to the third cause, insulation on steam lines should be checked if it is accessible. If the hammer is worse in certain buildings, and it is thought that condensation in the steam line is the cause, install a simple steam separator and trap where line enters the building.

If the hammer seems to originate in the reducing valve, a steam separator can be installed just ahead of it. The pressure drop through the separator would be no disadvantage, as the steam is throttled through reducing valve.

New York, N. Y. J E LANCASTER

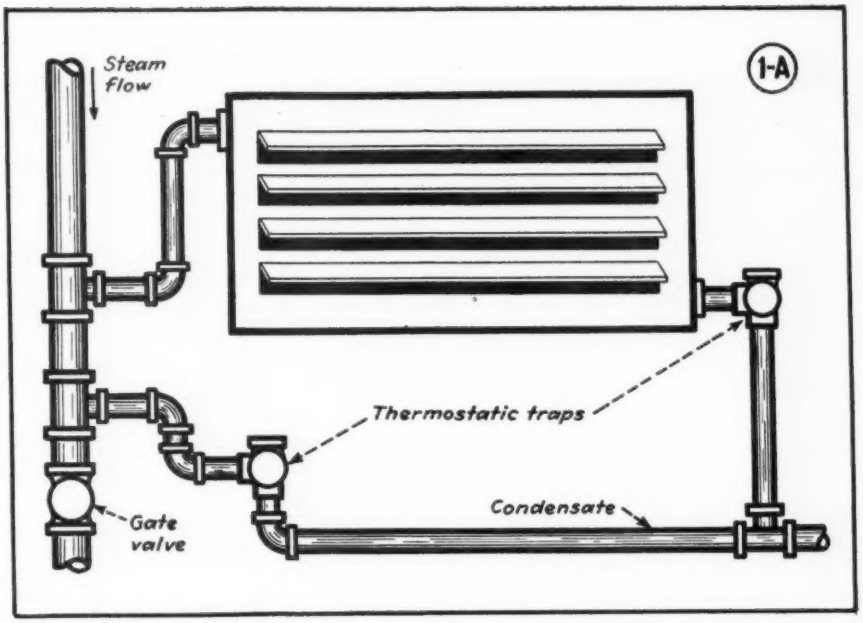
Reduce the Pressure

MOST OF WH'S TROUBLE is caused by radiators and mains not being vented properly. Steam pressure should be reduced from 5 to about 2 psi, but, if the air valves are faulty, the gravity system should be properly drained of water and vented of air.

We eliminated water hammer in our system by installing proper traps (ball type preferred).

Also, we got results by moving some radiators about 3 to 5 ft from the main, or riser, and increasing size of pipe leading to the trap, so that condensate cools more readily.

Philadelphia, Pa. C A WILKES



Look for Pipe Sag

WH SHOULD CHECK all pipes to see that they are pitched in the right direction to a trap, if one is used, and from trap to return. Use eccentric fittings when reducing pipe size. Remove all reducing tees.

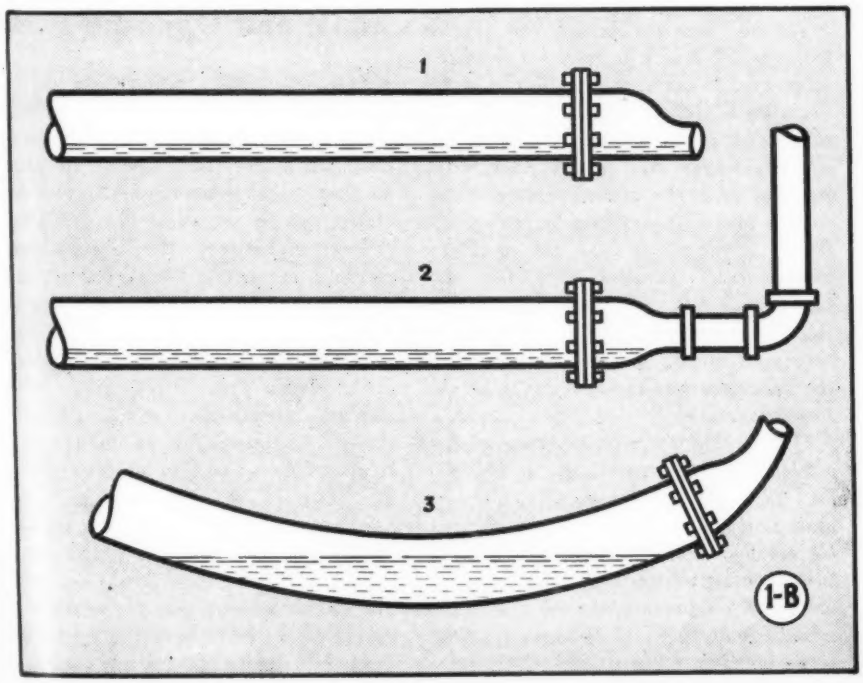
Examine lines closely for sag which usually occurs near couplings if pipe hangers are loose or broken. Do not fasten or hang any outside load on pipes. In a 1-pipe system, mains must be large enough to take care of reverse flow of condensate and have greater pitch. Inspect all traps and returns when they tie into mains; see that they are vented at this point.

Check buildings for settlement. Use expansion loops on long runs. If system has had additions, see whether mains are large enough to carry off additional condensation.

Install additional tanks and pumps nearer the trouble. The ones in use may be too small to relieve condensate fast enough to keep the system drained. If piping and radiators are installed correctly, you should consider vacuum pumps.

Sketch 1-B illustrates (1) eccentric reducing fittings showing free flow (2) ordinary reducing fitting, showing trapped water that results in hammer at the ell (3) a pocket formed by sagging pipe.

Baltimore, Md. C D PRICE



Use Thermostatic Traps

WH SHOULD FIRST DETERMINE whether the boilers are priming; then examine steam lines to assure that insulation is in good condition throughout; also provide a trap or traps as necessary according to pipe length and layout.

High-pressure line should be led as near to the hospital buildings as possible with necessary reducing valves installed at this point. All risers from them into the buildings must have drain legs and traps at the bottom, as in 1-A, whether up or down feed. They should also have a dirt pocket for removing sediment which may accumulate. This can be done by putting a gate valve or pipe cap on the lower end of the leg.

Put thermostatic traps on all lines leading into the return mains so that no water can accumulate in the individual radiators while the steam is shut off. This often causes severe hammer, not only at the source but is carried along the line to other parts of system. I would install a vacuum pump in each basement and maintain 3- or 4-in. vacuum to eliminate hammer.

Kearney, N. J. GEORGE MCNALLY

Look at Pump Motor Connections

ASSUMING THERE HAS BEEN no previous hammer, WH's system must have been installed properly. Inspect traps to see whether they are operating properly. If not, steam may be blowing through and striking condensate from other traps. Also, they may be clogged and

allow water to back up, especially those that drain low points in the main lines.

Next look for clogged lines. A piece of valve disk sometimes gets into the line or valve bodies and retards free water flow. When there is a lot of condensate it may cause the water to back up elsewhere.

Go over pump thoroughly because it may be in such shape that it cannot handle the condensate at all times. If it is an electric pump, see whether motor contacts are dirty. If it is a continuously running pump, it may not be running all the time because of bad electrical connections. Go over brushes, contacts, commutator and wiring. Then look over additions to the old system. If repairs have been made or new work put in, it may not be draining, or it may not have been put in properly. Dirt left in the lines, valves and fittings works its way into traps and valves.

Baltimore, Md. C W PARKS

Trouble Comes From Low Pressure

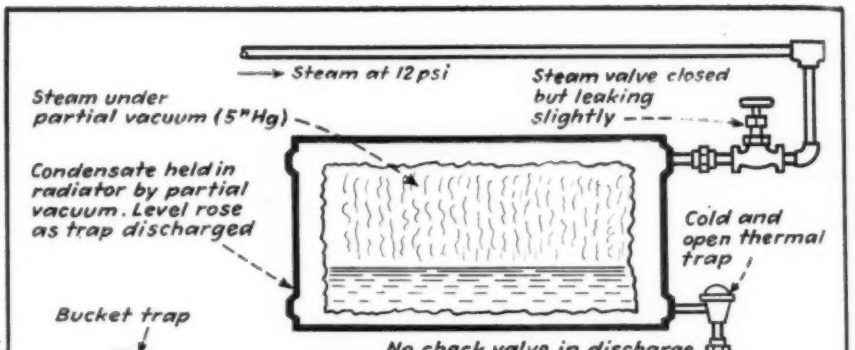
WATER HAMMER should be distinguished from the rattling of a partly open gate valve, pump vibration, fluttering of a pump or check valve, or the peculiar sound of a balancing bucket trap.

If WH's return is open to atmosphere and end of pipeline is submerged in the hotwell, subatmospheric steam pressure beyond the reducing valve may be the cause. Test pressure gage and regulator to make sure required 5-psi steam is maintained at all times. If steam pressure falls below that of atmosphere, there can never be a complete discharge of condensate from the system, especially if end of return line is submerged because atmospheric pressure forces the comparatively cold water back into the hot pipes and radiators. This water then returns by gravity, while hot steam contacts surfaces cooled by the water.

I once traced an aggravated case of hammer to a leaking steam valve and bucket trap, an undersized return line and the absence of a check valve on a radiator outlet, sketch 1-D. Although the sound spread throughout the system, the hammer was in an isolated radiator which was supposedly shut off. Its steam valve leaked just enough to keep the upper part of the radiator hot, while the condensate-covered bottom remained only a few degrees above room temperature of 50 F.

Hammer occurred at almost regular intervals, which seemed to place the source at a bucket trap that drained several steam kettles and discharged

(*Continued on page* 174)


Steam at 12 psi
Steam valve closed but leaking slightly
Steam under partial vacuum (5" Hg)
Condensate held in radiator by partial vacuum. Level rose as trap discharged
Cold and open thermal trap
Bucket trap
No check valve in discharge
Note: Several other radiators between this one and the bucket trap
1-D
Steam 80 psi
3/4-in. return line (atmospheric)

Answers to March Question 2

What Is the Secret of This Generator Hookup?

We have a 50,000-kw 13,000-v steam-turbine-driven ac generator which carries a 2000 kw 2300-v station auxiliary ac unit on its main shaft. Main generator leads go through an oil circuit breaker to a spur bus and then through other ocb's to the main powerhouse bus, which feeds outgoing cables and transformer lines.

A 13,000/2300-v station-service transformer has its high-voltage winding connected through disconnects to the 13,000-v spur bus. Low-voltage winding connects to the station service bus through an air circuit breaker. Leads from auxiliary generator on the main-unit shaft connect to this station service bus through an acb.

Normal practice is for the service transformer, which is back fed from the main bus, to carry the auxiliaries when main unit is shut down. Upon starting this unit it is paralleled with the system over the spur bus which puts it in parallel with the station-service transformer and 5,000-kw load is picked up. While holding this load the auxiliary generator is parallel with the station-service bus. Section breaker in the station-service bus is then opened, putting part of the station auxiliaries on the generator and the remainder on the transformer.

If the auxiliary generator can be paralleled when the main unit carries 5000 kw, why can't it be paralleled when main unit is carrying full load? What is the reason for having one rotor of these two machines advanced in relation to the other? What precautions must we take when dismantling and disconnecting the leads on these generators?—PT

Voltages Must Be Equal and Opposite

FIRST, CONSIDER conditions necessary to synchronize two machines. Voltages at the point where they are synchronized must be equal and opposite in phase so that no current flows. In two machines not on the same shaft, a phase difference between the two voltages causes a current to flow between them. The fast machine supplies power to the slow one, thus speeding it up and slowing down the fast one until the voltages are in phase.

When two machines are on the same shaft, it is impossible to change their relative speeds; so that while synchronizing current flows, no change in terminal-voltage phase relation is possible except by voltage drop in machines and bus. Larger currents flow than when the machines were not physically connected because the power must be dissipated by losses.

Vector diagram 2-B explains the phase relations of this unit. Since no current is flowing in the 2000-kw generator, the generated voltage E_2 is equal to the terminal voltage at the station-service circuit breaker, V_2. Current flowing in the circuit must be adjusted so that voltage V_1 at the 50,000-kw side of the station-service circuit breaker is equal and opposite to V_2, remembering that voltage drop through transformer and bus are fixed by the station-service load both as to phase and magnitude.

Since we also have voltage drop within the generator and external circuit, E_1 must lead V_1 by an angle, depending upon the value of these voltage drops; therefore, the rotor of the 50,000-kw machine must be advanced in rotation with respect to the rotor of the 2000-kw machine. Amount of advance is determined by the voltage drops involved, which, in turn, depend upon the circuit constants and the magnitude and phase relation of the currents. Conversely, the amount and phase relation of the currents depend upon the angular relation between the two rotors, once the angle of advance is fixed.

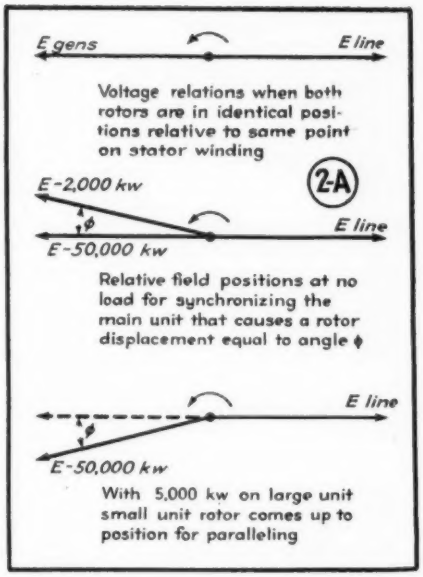
Angle between E_1 and E_2 is fixed by position of the rotors on the shaft. I' is fixed both in direction and magnitude by the local service load. This controls I'r' and I'x'. V_1 is fixed in direction for synchronizing because it must be opposite to E_2. E_1 is variable in magnitude. This controls the magnitude and direction of V_1, and since V_1 is fixed in direction, only generator and line currents are variable in direction and magnitude, and they are interdependent. They are further controlled by the generator load.

Since resistance r_1 and reactance x_1 are small, changes in current for small changes in voltage will be relatively large. Load at which the two machines are synchronized is such that a reasonable value of voltage, current and power factor is obtained.

If the main generator load were increased to 50,000 kw, the I_1r_1 and I_1x_1 drops would be increased considerably, reducing V_1 and making the generator supply a heavy current. Its power factor would then be poor. The current required to bring V_1 into its proper phase relation might exceed the machine's rating and open the main-generator circuit breaker by overcurrent relay.

It should be necessary to take only routine precautions when disconnecting the leads on these generators, such as tagging all leads to avoid error in connection when reassembling. Should an error be suspected, a potential transformer connected across the air-circuit-breaker terminals between the 2000-kw machine and local service bus permits checking phase rotation before synchronizing either machine.

Boise, Idaho FRED MCCORMACK


E gens
E line
Voltage relations when both rotors are in identical positions relative to same point on stator winding
2-A
E-2,000 kw
E line
E-50,000 kw
Relative field positions at no load for synchronizing the main unit that causes a rotor displacement equal to angle ϕ
E line
E-50,000 kw
With 5,000 kw on large unit small unit rotor comes up to position for paralleling

Check Phase Rotation

Parallel operation of two ac generators of different size and design, driven by a prime mover on a common shaft, introduces complications that are not present when the same machines are independently driven.

Parallel operation of ac generators requires that: (1) frequencies be identical, (2) voltages be equal in magnitude, (3) phase position be such that the two voltages are opposite, (4) wave forms be alike and (5) phase rotation be the same.

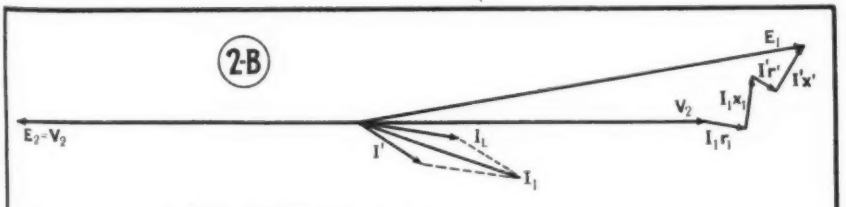
To carry load, an ac generator must shift its relative pole position (from position of synchronism at no load) forward by an angle sufficient to produce a resultant voltage between generated and applied voltage. And as the second unit, being rigidly connected to the loaded unit, must also shift through the same mechanical angle it follows that at the time of paralleling the main unit, the second unit cannot supply a voltage in exact opposition to the system voltage.

Vectors in 2-A show that if the rotors are positioned identical to the terminal coil in phase *A* of each machine, the only position of synchronism must occur with both machines at no load.

If it is desired to parallel with a certain loading on the large unit, the small unit's rotor must be so relatively positioned that it lags behind the main unit by an angle equal to the angular displacement caused by the load. At this load the small unit can be successfully paralleled because it now generates a voltage in opposition to the line voltage.

When dismantling, all leads should be marked so they can be reconnected properly. In any event, check phase rotation to avoid damage from wrong connections.

Hamilton, Ont. J A COULDEN



E_1 = Generated voltage of 50,000-kw machine
E_2 = Generated voltage of 2,000-kw machine (Measured at one side of auxiliary bus circuit breaker)
V_1 = Voltage of 50,000-kw machine after internal drops and drop through transformers have been deducted (Measured at the other side of auxiliary bus circuit breaker)
I_1 = Load current of 50,000-kw machine
I_L = Load current of 50,000-kw machine delivered to main bus
I' = Current going through transformers to station service
r' = Resistance from spur bus to auxiliary circuit breaker, including that of transformers
x' = Reactance of spur bus to auxiliary bus including transformer
r_1 = Internal resistance of 50,000-kw machine
x_1 = Internal reactance of 50,000-kw machine

Load Steadies Unit

ANGULAR POSITION OF THE ROTOR in an ac synchronous machine bears a certain relationship to a similar angular position of a polyphase ac circuit to which the machine is connected. This position is not fixed but varies with amount and direction of power flow (whether the machine is generating or absorbing power). As a synchronous motor is loaded its rotor lags, as compared with the similar angular position of the poly-

(*Continued on page* 176)

Q&A QUESTIONS & ANSWERS FOR POWER ENGINEERS

By ALEX HIGGINS

14—*Fuel-Gas Analysis: Method and Meaning*

Fourteenth in a series that is running in every number of* POWER. *From long experience as a professional and practical engineer, Alex Higgins asks and answers some direct questions regarding power equipment — its construction, principle, maintenance, efficiency and safe operation. In outstanding fashion he drills the young power engineer, polishes up the oldtimer's knowledge, helps all comers pass engineer examinations and win certificates of higher grade. Besides being invaluable as a study course for examinations, it is a good review for the chief himself who wants to do a better job.—Editor

Q 1—What is flue gas?

A—It is the name given to the complete and incomplete products of combustion, and excess air, passing to the chimney. Commonly considered constituents are water vapor (H_2O), carbon dioxide (CO_2), carbon monoxide (CO) and nitrogen (N_2).

Q 2—What constituents are measured in the ordinary commercial analysis of flue gas?

A—Ordinary *orsat* apparatus cannot measure moisture. It directly measures the percentages by volume of carbon dioxide, oxygen (O_2), and carbon monoxide in dry flue gas. Remainder is assumed to be nitrogen.

Q 3—What is the flue-gas analysis if carbon is the only combustible element in the fuel and if combustion is complete?

A—When carbon burns completely with one volume of oxygen, it produces one volume of carbon dioxide and no carbon monoxide. Note that air contains 21% oxygen by volume and 79% nitrogen. The nitrogen goes through the furnace unchanged. Any oxygen that burns completely with carbon produces the same volume of carbon dioxide. The remainder of the oxygen is excess and goes through unchanged. Thus, the flue gas here analyzes 79% nitrogen, and the oxygen and the carbon dioxide add up to 21%.

Thus, if there is no excess air the analysis is:

	Percent
Oxygen	0
Carbon dioxide	21
Nitrogen	79
Total	100

If there is 100% excess air, unburned oxygen equals that burned to carbon dioxide, and gas analysis is:

	Percent
Oxygen	10.5
Carbon dioxide	10.5
Nitrogen	79.0
Total	100.0

If there is 50% excess air, the unburned oxygen is half that burned to carbon dioxide, and the gas analysis is:

	Percent
Oxygen	7
Carbon dioxide	14
Nitrogen	79
Total	100

Q 4—What is the effect on the flue-gas analysis if the fuel contains no combustible, except carbon, and if part of the carbon is incompletely burned to carbon monoxide?

A—The original oxygen now goes in three directions. Part goes through unchanged. Part burns completely to form the same volume of carbon dioxide. The remainder burns incompletely to form twice its volume of carbon monoxide.

Q 5—What is the effect of hydrogen in the fuel?

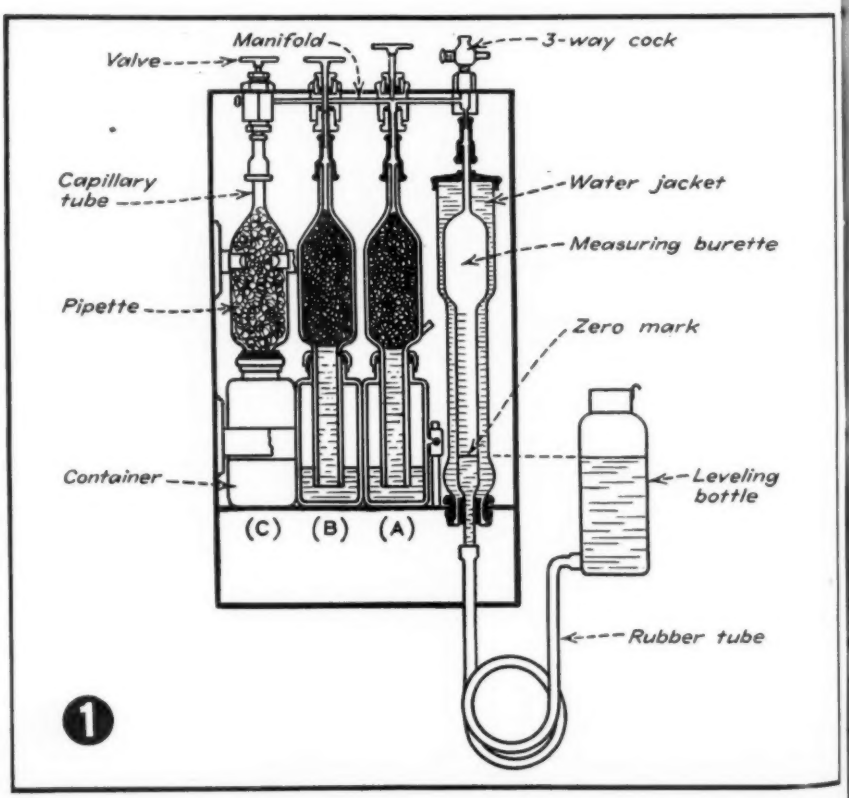
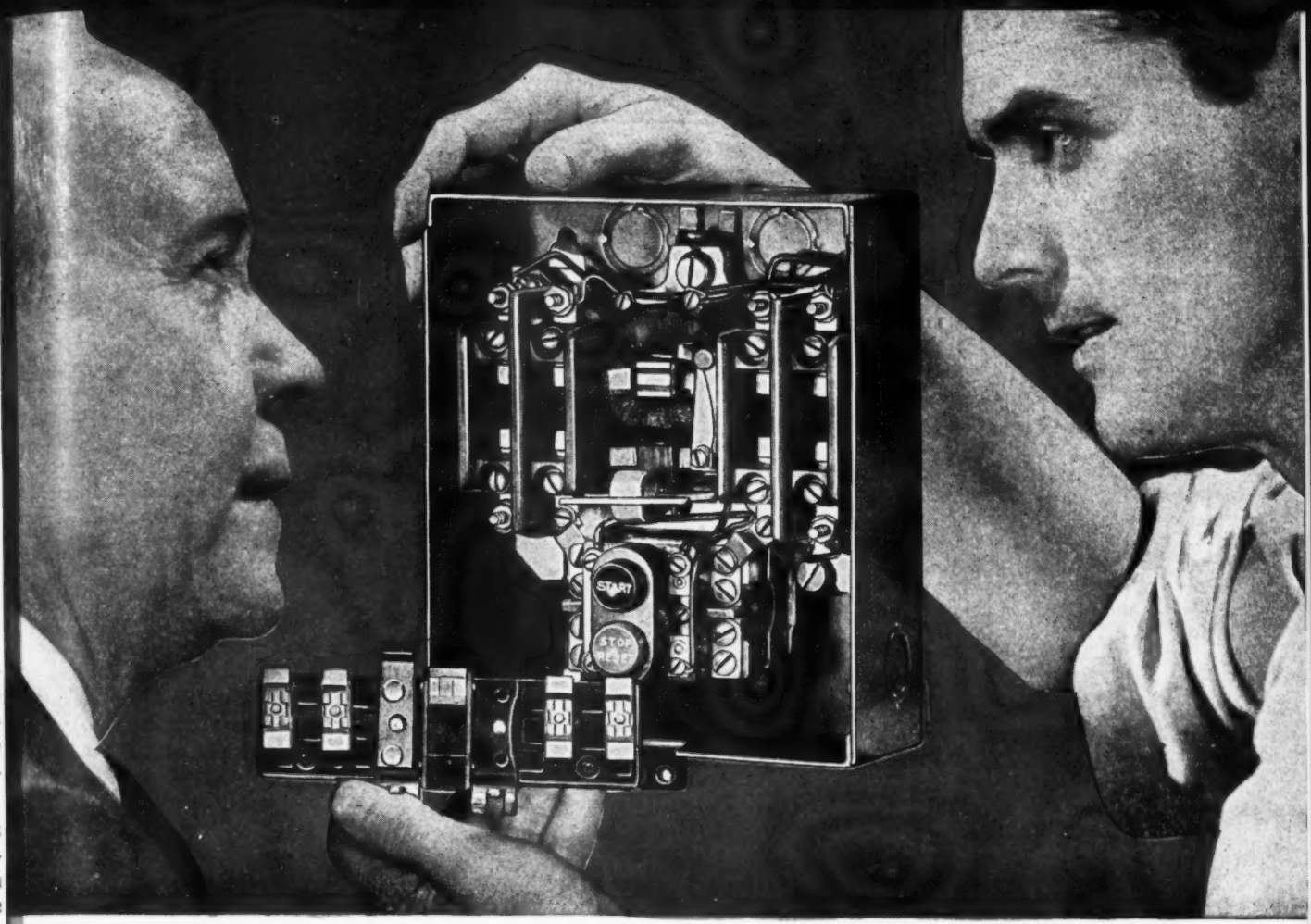


Fig. 1—Common type of orsat to analyze flue gas for CO_2, O_2 and CO



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Engineering Excellence Finds its Greatest Reward in the Respect and Confidence of those it Serves

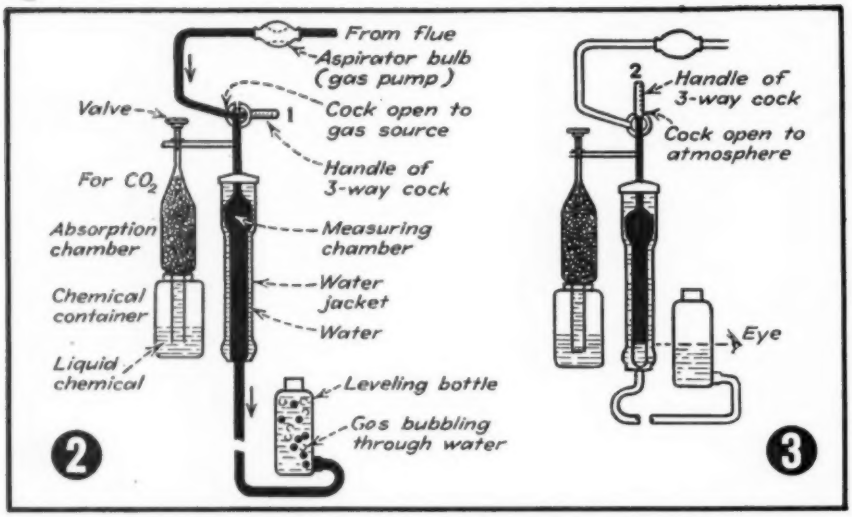

Fig. 2—*Step* 1: Pump aspirator bulb to fill burette with flue gas. Fig. 3—*Step* 2: Bring sample to zero mark at atmospheric pressure

A—Hydrogen burns with part of the oxygen to produce water. This condenses and does not show up in the orsat analysis, so it is equivalent to a shrinkage.

Q 6—Illustrate the combined effect of all these by an example.

A—Suppose that out of the 21 cu ft of oxygen, in 100 cu ft of air, 4 cu ft is excess going through unchanged, 1 cu ft burns to make 2 cu ft of carbon monoxide, 13 cu ft burns to 13 cu ft of carbon dioxide, and 3 cu ft burns with hydrogen to produce water. The 79 cu ft of nitrogen goes through unchanged.

First column below gives the products of combustion in cubic feet, and second column in percent:

	Cu ft	*Percent*
Oxygen	4.0	4.1
Carbon monoxide.....	2.0	2.0
Carbon dioxide.....	13.0	13.3
Water (disappears).....	0.0	..
Nitrogen	79.0	80.6
	98.0	100.0

In this problem, carbon monoxide is purposely shown higher than would normally occur in boiler operation. Generally the figure is less than 1%.

Q 7—Sketch and describe an apparatus for analyzing flue gases.

A—Orsat apparatus, Fig. 1, is a common type of flue-gas analyzer. Its principal parts are a water-leveling bottle, a water-jacketed measuring burette, three pipettes, three containers, various connecting tubes and valves and a frame to hold all these parts rigidly in position.

The leveling bottle and measuring burette contain pure water. The first pipette, *A*, is packed with steel wool, kept wet with caustic-potash solution from the container below. The steel wool in the second pipette, *B*, is wet with pyrogallic solution from the lower container. The third pipette, *C*, contains copper strips wet with cuprous (copper) chloride solution.

Pipettes *A*, *B* and *C* are for the absorption of carbon dioxide, oxygen and carbon monoxide, in the order named. Other chemicals than those indicated are sometimes used for these absorptions.

This orsat is connected to the sampling tube in the stack or breeching by a length of rubber tubing in series with an aspirator rubber bulb (Fig. 2) to pump the gas and (generally) a gas filter (glass wool in a glass tube) to remove dust and tar. The gas line connects to the back side (not shown, Fig. 1) of the 3-way cock. This cock has three positions: (1) To connect sampling tube to measuring burette. (2) To connect burette to atmosphere. (3) To connect sampling tube to atmosphere. (This last position is *closed* as far as orsat is concerned).

Q 8—Explain how a flue-gas analysis is made, using indicated type of orsat.

A—Following covers the main steps only. For actual operation always study detailed instructions supplied with the particular instrument. These show how to avoid contamination of the sample with air or of the chemical with water, or vice versa—also how to insure easy operation and precise readings.

Step 1—(Fig. 2) Use hand aspirator bulb to pump gas through measuring burette. It bubbles out of measuring bottle as shown. Continue until sure that all air has been displaced.

Step 2—(Fig. 3) With 3-way cock set to connect burette to atmosphere, raise leveling bottle slowly until water is at zero mark near bottom of burette. This is also level with water in bottle, so sample is measured at atmospheric pressure. (All gas measurements must be made at atmospheric pressure, that is with water level the same in burette as in leveling bottle).

Step 3—(Fig. 4) To absorb CO_2, close 3-way cock and lift bottle high. Open valve to CO_2 pipette, so gas displaces liquid and contacts caustic solution on steel wool, which absorbs CO_2. Pinch tube to check flow when water rises to mark in capillary tube above burette. Allow a few seconds for CO_2 absorption.

Step 4—(Fig. 5) Next, keeping tube pinched, lower the bottle. Then release

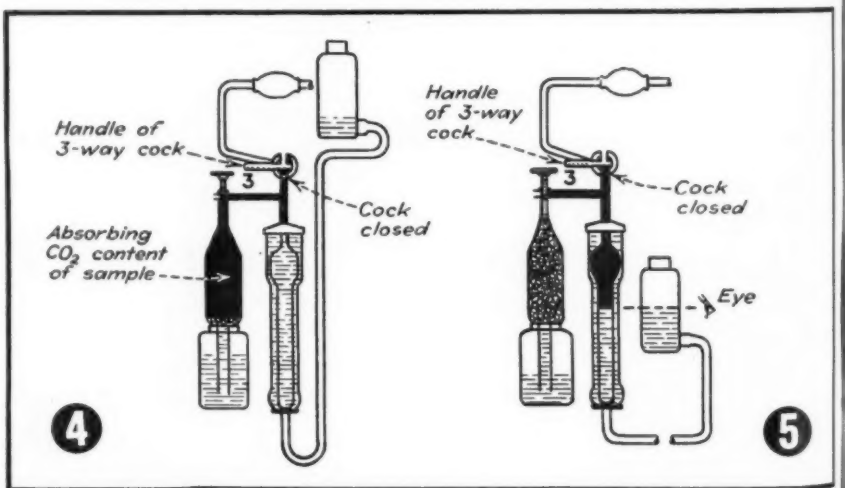

Fig. 4—*Step* 3: Transfer sample to absorption pipette. Fig. 5—*Step* 4: Return sample to burette and measure the remaining gas at atmospheric pressure. The reduction in volume is percentage of constituent

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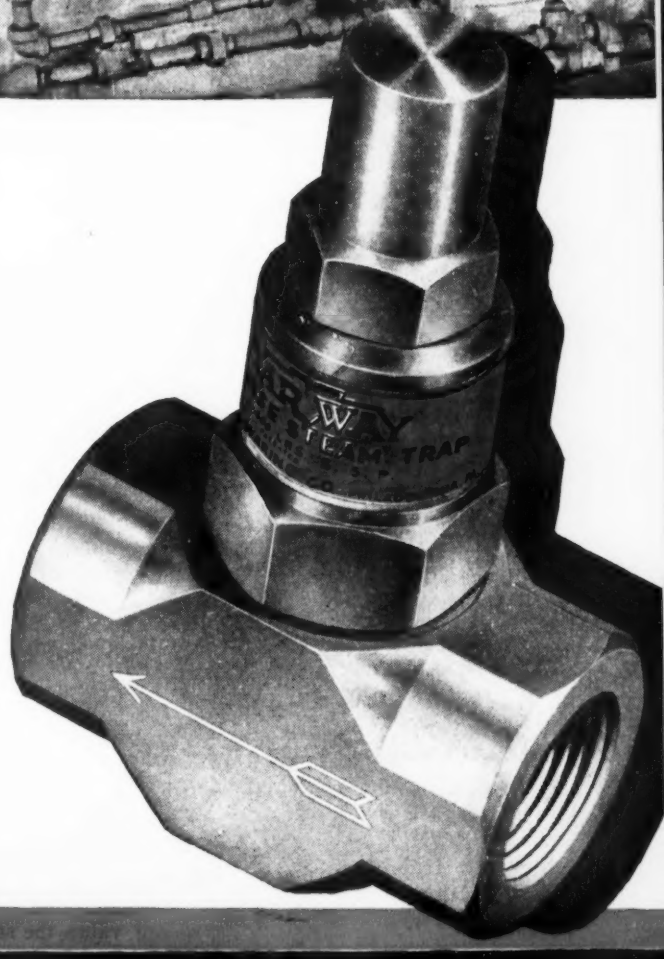


YARWAY IMPULSE STEAM TRAP

Corresponding Percentages of CO_2, O_2 and Excess Air

Kind of fuel	*Ingredients*	*Percent excess air* 0	20	40	60	80	100
Anthracite	CO_2	19.5	16.0	13.8	12.0	10.7	9.6
	O_2	0.0	3.5	6.1	8.0	9.4	10.6
Bituminous	CO_2	18.6	15.5	13.2	11.5	10.1	9.2
	O_2	0.0	3.5	6.0	8.0	9.5	10.6
Fuel oil	CO_2	15.5	12.6	10.6	9.3	8.2	7.4
	O_2	0.0	3.7	6.4	8.1	9.6	10.8
Natural gas	CO_2	12.2	10.0	8.5	7.5	6.5	5.7
	O_2	0.0	4.0	6.5	8.5	9.9	10.9

Note: Where gas contains CO, substitute for CO_2 the sum of the CO_2 and half the CO. Thus, if CO_2 is 12% and CO is 2%, equivalent CO_2 is 13%.

rubber tube cautiously until liquid rises exactly to the mark in capillary tube on top of pipette. After closing pipette valve, raise or lower bottle until water level in bottle is exactly same as in burette. Read graduation at water level in burette. This is CO_2 percentage. Repeat steps 3 and 4 to make sure all CO_2 is absorbed.

Step 5—Repeat steps 3 and 4 for pipette *B* to absorb the O_2. The *increase* in burette reading is percentage of O_2.

Step 6—Again repeat steps 3 and 4 with pipette *C* to absorb the CO. The *further* increase in burette reading is the percentage of CO_2.

Q 9—What are some of the peculiarities of the chemicals used in the orsat?

A—The caustic to absorb CO_2 acts surely and rapidly. This solution need not be protected from the air and lasts a long time. The CO_2 should always be absorbed first.

The solutions for absorbing O_2 and CO act more slowly, and must be protected from contact with the air. If the O_2 is not completely absorbed in pipette *B*, it will be in pipette *C* and will therefore be erroneously reported as part of the CO. Be sure O_2 is *completely* absorbed in *B*.

If a second pass through any pipette produces no increase in absorption, it may generally be assumed that the solution is in good shape.

Q 10—Give an example of readings during an orsat analysis.

A—Reading after CO_2 absorption, 12.8%; after O_2 absorption, 18.7%; and after CO absorption, 19.8%. Then analysis is:

CO_2 ..... 12.8%
O_2(18.7 − 12.8)..... 5.9%
CO (19.8 − 18.7)..... 1.1%

Q 11—What gas analysis results are reasonable?

A—The following comments hold only for solid or liquid fuels (not for gas fuels): The sum of the CO_2, O_2 and half the CO should never be above 21. With coal this sum should never be less than 18.5. With fuel oil, the sum should never be less than 15.5.

Q 12—Assuming there is no CO in the gas, give a table showing the percentage of CO_2 for various percentages of excess air with typical anthracite coal, bituminous coal, fuel oil and natural gas. Also show for each CO_2 percentage about what the O_2 should be as a check on the analysis:

A—The table is given above.

Q 13—Which is the more reliable indicator of excess air, CO_2 or oxygen?

A—Table for Q 12 shows that oxygen percentage is the more reliable indicator, because it reads about the same for any coal, and almost the same for oil as for coal. For any coal or fuel oil the excess air can be closely estimated from the oxygen by the following rule.

Subtract the oxygen percentage from 21. Divide the oxygen percentage by this difference and multiply by 100 to get the percentage of excess air. Example: What is the percentage of excess air for coal or oil if the oxygen in the flue gas is 8.3%? Solution: 21−8.3=12.7. Then 8.3÷12.7=0.65 and 0.65×100=65% excess air.

Q 14—Give some typical flue-gas analyses for bituminous coal firing under various conditions.

A —	% CO_2	% O_2	%CO	% N_2 (by difference)
Poor	9	10.5	0.5	80.0
Average	12	7.5	0.1	80.4
Good	15	4.0	0.2	80.8

Note (from table in Q 12) that the last condition above corresponds to less than 20% excess air. Any further reduction in excess air would undoubtedly raise the CO excessively.

Q 15—What percentage of CO_2 do you expect when burning natural gas under good conditions?

A—Because of the high hydrogen content of natural gas, 20% excess air, which is about the practical minimum, corresponds to about 10% CO_2.

Q 16—What percentage CO_2 would you expect when burning fuel oil under good conditions?

A—The carbon content is relatively higher in fuel oil than in natural gas, and so the attainable percentage of CO_2 will be higher (but less than with coal). With 20% excess air, CO_2 with oil fuel should be about 12.5%.

Use a Less Critical Coal?

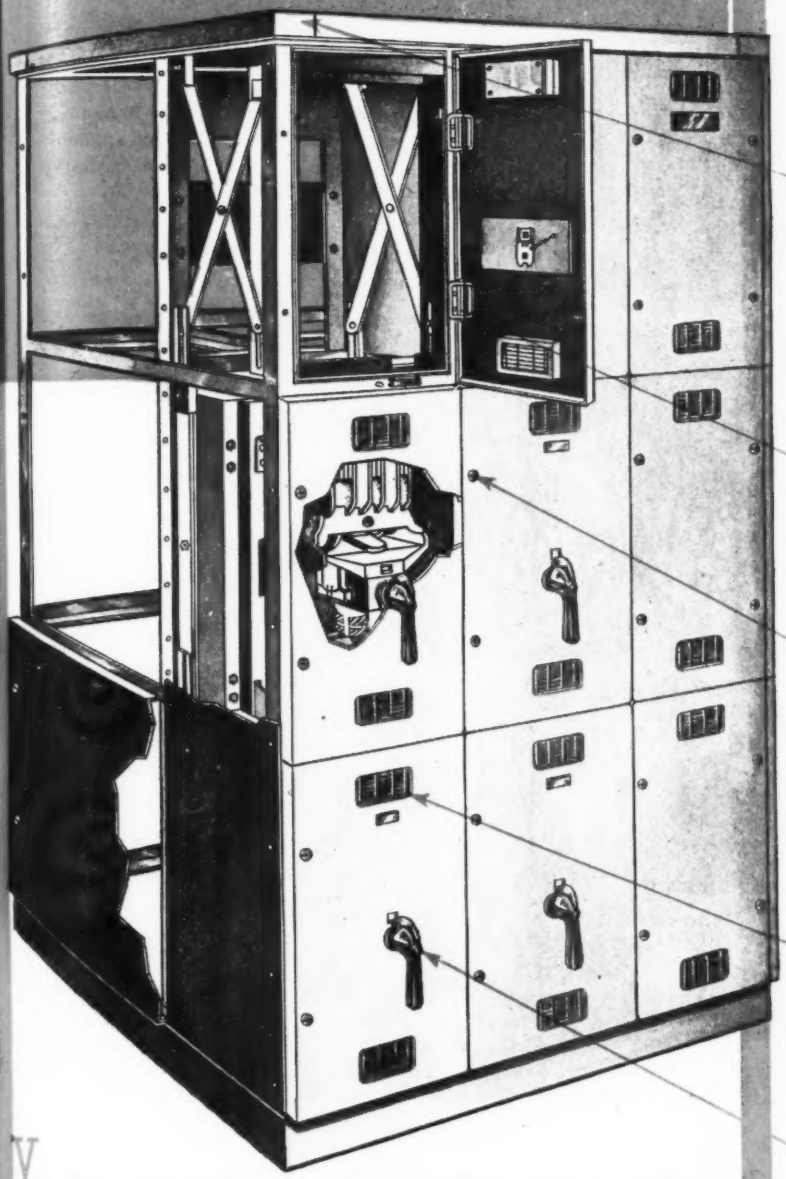
(*Continued from page* 104)

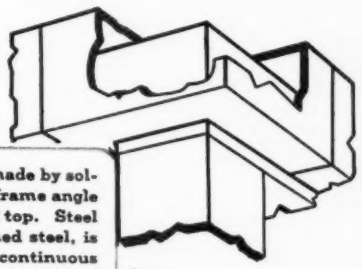
material change. Average evaporation rate for the past 36 months has been approximately 9.4 lb of water per lb of coal as fired; coal consumed during the same period was 16,368 tons of bituminous and anthracite.

Coal usage averages 5500 tons per year generating approximately 110 million pounds of steam, part of which generates 800,000 kwhr of electrical energy; the remainder supplies heat and other services. Any other plant under similar conditions now burning all bituminous, can, by burning a 50-50 mixture, save approximately 2500 tons. Allowing for anthracite's lower heating value, the saving would still be a worthwhile contribution to the war effort.

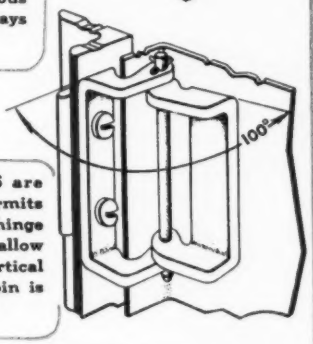
Chief engineer Carlsen says that this combination has saved about 25% in actual fuel cost, and that the labor of slicing and leveling the fire has been reduced to attention needed only when cleaning. He attributes the saving to (1) relatively low cost of anthracite screenings (2) freight differential compared to bituminous whenever he uses straight barley anthracite in place of yard screenings (3) successful use of a lower grade bituminous—a slack coal instead of run of mine, and (4) high furnace efficiencies, with minimum attention to either the stoker or fuel, when this fuel is well mixed.

N DETAILS TOO—YOUR NEEDS GUIDE DESIGN OF I-T-E DRAWOUT SWITCHGEAR

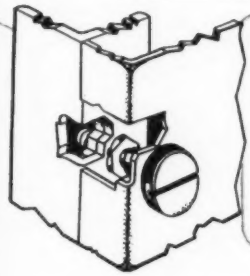




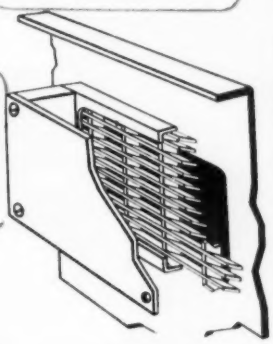
CORNERS are made by solidly welding frame angle to sheet-steel top. Steel trim, of formed steel, is added as a continuous finishing member always in alignment.



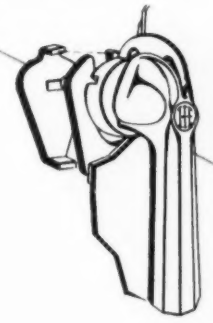
CONCEALED HINGES are sturdy. Design permits 100° swing. Slots in hinge and frame-angle allow horizontal and vertical alignment. Hingepin is readily removable.



PANEL SCREW has large head chamfered to prevent marring of finish. Palnut keeps screw attached to door at all times. Floating nut-block permits adjustment so that screw can be perfectly aligned with fastening thread.



LOUVERS are grille type, giving adequate air flow. Mounting is flush. Baffling is used when ventilating opening is close to arc chutes.



OPERATING HANDLE, mounted on front of door, disengages automatically when door is opened. Only 90° turn is required to close or trip the circuit breaker. Handle may be padlocked in open position.

You buy switchgear for long-term service. You want everything to be strong and dependable throughout. When a door is opened, you want it to swing far enough to give full access. To have ventilation, you want something more than a few holes "bumped" into a sheet of metal; you want louvers designed with plenty of engineering thought. With I-T-E switchgear you get careful design down to the last detail.

To plan switchgear, have a description of I-T-E design details at hand. Let an I-T-E engineer go over them with you. Have them written into your specifications. Descriptions are available in Bulletin 4207.

Representatives in Principal Cities

I-T-E

AIR SWITCHGEAR

IMMERSED IN AIR — ENCASED IN STEEL

The Army-Navy "E" for Production Excellence

I-T-E

CIRCUIT BREAKER CO., PHILADELPHIA 30, PA.

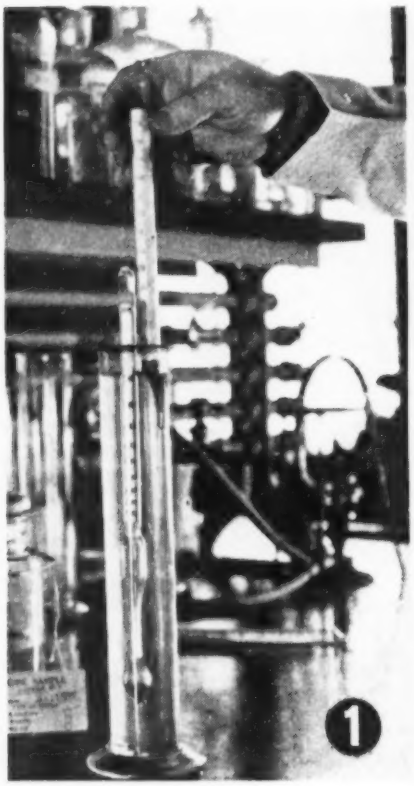
HOW TO TEST BRINE FOR REFRIGERATION

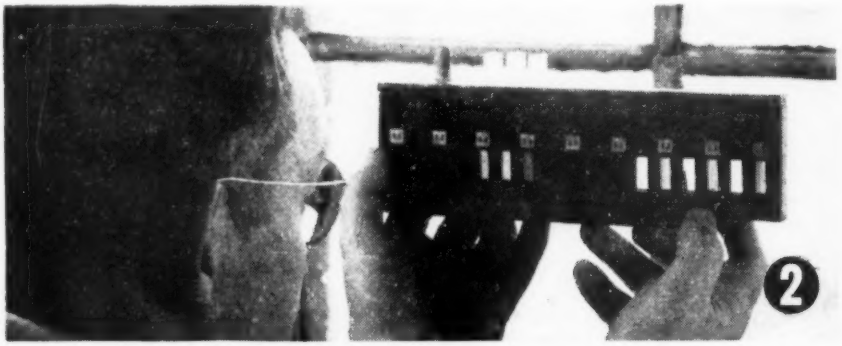
AN EFFICIENT REFRIGERATING BRINE must remain liquid at the lowest temperature at which it is to be used and its corrosive effect on piping and cans must be held to a minimum. Freezing would form ice on evaporator coils, reducing their heat transfer and, in time, would choke up restricted brine passages. Operating at low temperatures requires brine at higher specific gravity, which results in its having a lower specific heat.

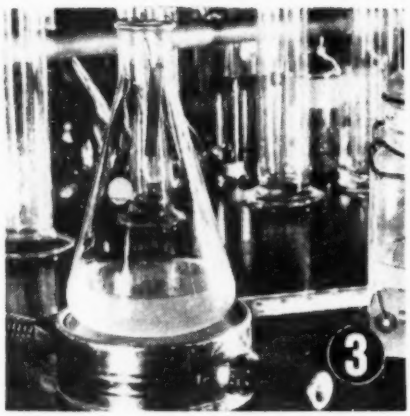
Corrosive brines cannot be tolerated because replacing metal cans and piping is costly. Since iron corrodes more readily in brine of low pH and zinc is damaged at relatively high pH values, it is vitally important to maintain the pH level at the best intermediate point (approximately 7.5 to 8.5).

Be sure refrigerating brine is kept in good condition by testing it monthly for: specific gravity, pH, free ammonia and percentage of corrosion inhibitor.

Photographs, courtesy Borden's Farm Products, division of Borden Co







1 *Specific gravity* Test for specific gravity by first pouring a sample (at 60 F) in a tall cylinder or jar. Float a hydrometer or salinometer in the liquid and read the scale where it coincides with brine level (not top of meniscus). Insert a thermometer to determine brine temperature; if it is above or below 60 F, specific gravity reading must be corrected by a factor given in brine tables. If brine specific gravity is not within desired range make necessary adjustments

2 *Hydrogen ion or pH* Degree of brine alkalinity or acidity may be expressed in terms of pH. A pH of 7.0 represents neutrality, values above this represent increasing alkalinity and below 7.0 increasing acidity. You can measure pH by either potentiometric or colorimetric methods. Photo shows colorimetric method comparing test sample against adjusted color standards. Use a slide comparator-indicator solution combination that registers the brine's correct pH near the midpoint of comparator scale

3 *Free ammonia* (ammonia leakage) Ammonia in the brine can be detected by smell when more than a trace is present. Smaller amounts can be detected by heating 50 or 100 ml of brine in an erlenmeyer flask in which a moist strip of red litmus paper is hung (photo). The litmus paper turns blue when a small amount of ammonia is present. Adding a little alkali (caustic soda) helps to free the ammonia more readily. Presence of an appreciable quantity of ammonia also increases the brine's pH. Litmus paper may not give reliable results when dipped into strong alkaline calcium-chloride brine because this salt itself tends to turn the paper blue

4 Nessler's solution can be used to test calcium-chloride brine for free ammonia (leakage) if enough sodium carbonate is added to sample to precipitate the calcium. Filter the sample and add several drops of Nessler's solution; color becomes yellow to dark brown if ammonia is present

(*Continued on page* 122)

THERE'S MORE THAN ONE WAY TO kill Algae!

PHOTOS IN NALCO LABORATORIES

BUT *Nalco* OFFERS THESE ADVANTAGES:

1. Formulated for slime organisms in industrial waters.
2. Non-corrosive—it will not attack metal or other substances.
3. Non-volatile—none is lost even if water is aerated.
4. Organisms do not build up a resistance to it.
5. Not affected by any other materials present in the water.
6. Effectiveness is not reduced by high alkalinity.
7. Non-toxic in normal quantities (although not recommended for treatment of water for domestic consumption.)
8. Supplied in convenient ball form for feeding through inexpensive Nalco Feeder.

Now is the time to plan to keep cooling towers, cooling systems, condensers and other equipment free of Algae and slime. Write to Nalco today and ask for Bulletin 31.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place • Chicago 38, Illinois

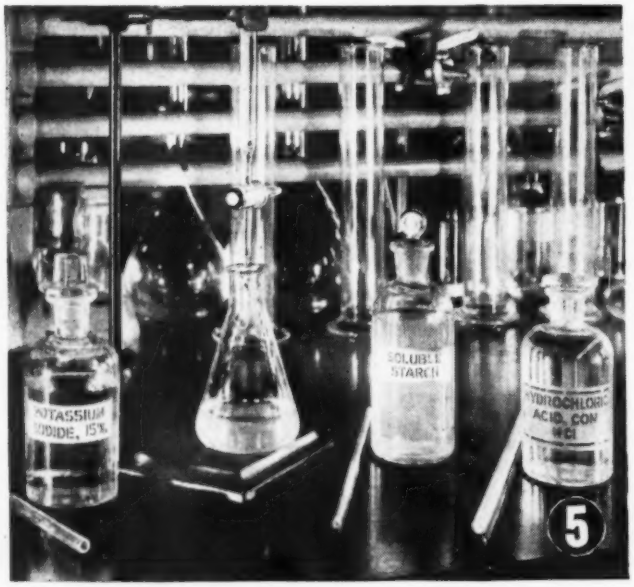
PAIGE-JONES CHEMICAL COMPANY

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

Nalco

SYSTEM OF WATER TREATMENT

HOW TO TEST BRINE FOR REFRIGERATION (*Continued from page* 120)



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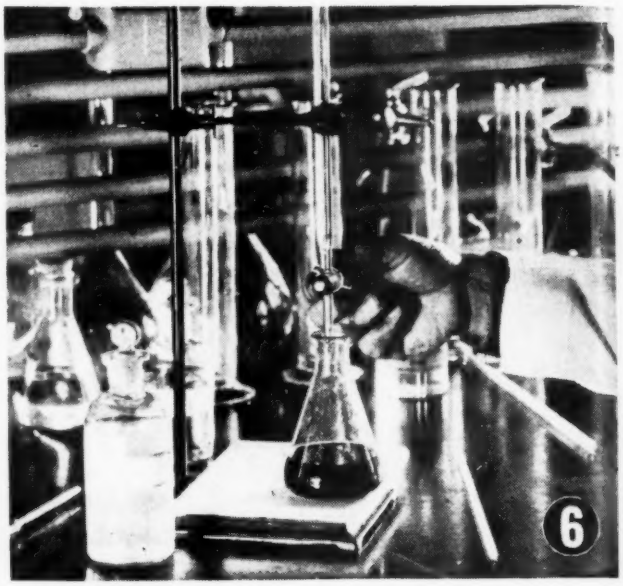
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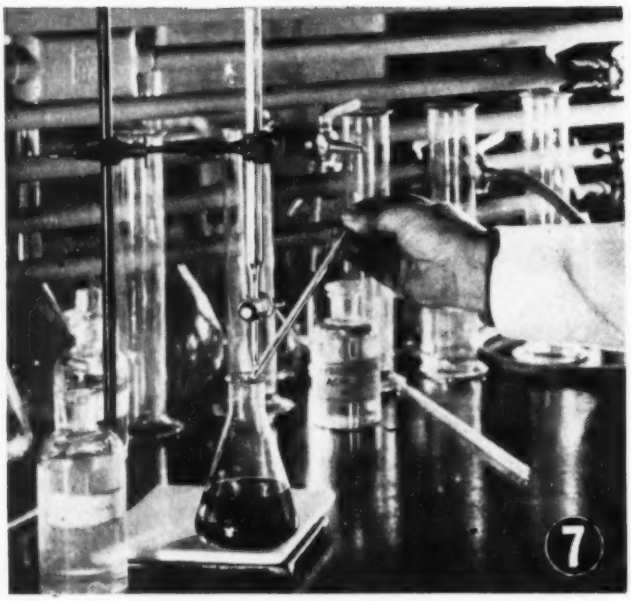
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8

5 ***Corrosion inhibitor (sodium bichromate)*** **Tests for corrosion inhibitor (sodium bichromate) require several pieces of laboratory equipment to simplify the operations. These include a 50 cc burette with stand, a 500 ml erlenmeyer flask and a separate pipette for each test solution. Avoid interchanging pipettes during test and guard against diluting the chemical solutions. Chemicals needed are: 15% solution of potassium iodide, concentrated hydrochloric acid, 0.10 N sodium thiosulphate, and soluble starch solution.**

6 **Measure 50 milliliters of a settled and filtered brine sample into an erlenmeyer flask. Foreign substances affect the test. With a pipette add 5 ml of the potassium iodide solution, followed by 3 to 5 ml of concentrated hydrochloric acid and mix with a rotary sweeping motion after each addition. Insert a stopper and allow to stand two or three minutes. Color of sample should now be brown. Pour the 0.10 N sodium thiosulphate reagent into the burette and titrate the sample until brown nearly disappears**

7 **Now add 0.5 to 1.0 ml of soluble starch solution and mix as before. Color should be a deep blue. Complete the titration with 0.10 N sodium thiosulphate drop by drop until the color changes from blue to bright green. Color change occurs rapidly and indicates end point of titration. Green must remain for at least 30 seconds to indicate a positive end point**

8 **One milliliter of 0.10 N sodium thiosulphate equals 0.004967 grams of sodium bichromate. When using a 50 ml sample, the percentage inhibitor in terms of sodium bichromate is the number of ml of 0.10 N sodium thiosulphate used, divided by 100. Hold concentration at 0.20% sodium bichromate**

An unusually practical article describing methods of adjusting brine pH and how to determine quantities of chemicals to add will appear in an early issue.

STEEL *Identity!*

In addition to the Ladish name, nominal pipe size, pressure rating, steel specification and trademark, each Ladish forged flange carries its steel *heat code* permanently stamped into it and so enables the user to secure, at any time from Ladish Drop Forge Co., certified reports attesting the actual chemical analysis and physical properties of the particular heat from which the flange was forged. This data is derived from complete chemical, spectrographic and physical analyses made in the Ladish Metallurgical Engineering Laboratories from the specific steel from which the flange is forged.

Steel identity stamped on each flange was pioneered by Ladish and has been a Ladish standard for many years

ARMY E NAVY

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY · WISCONSIN

MILWAUKEE SUBURB

TO MARK PROGRESS

FOR THE ENGINEERS' BOOKSHELF—

Modern Turbines
By Newman, Keller, Lyons and Wales

Maintenance and Servicing of Electrical Instruments
By J Spencer

Primer of Electronics
By D P Caverly

Electron—Optics
By Paul Hatschek

The Power Industry and the Public Interest
Pub by 20th Century Fund

Beloved Scientist
By D O Woodbury

Diesel Engine Catalog (vol VIII)
Edited by Rex W Wadman

Turbines

MODERN TURBINES *by Newman, Keller, Lyons and Wales, all of General Electric Co. Edited by Louis E. Newman, turbine division, General Electric Co. Published by John Wiley & Sons, 440 Fourth Ave, New York, N. Y. 175 pages, 5½x8½ in., illustrated.* $2.75.

A little book that should be in the hands of every turbine operator before he modernizes or expands his plant. Here is the answer to fitting industrial plants with backpressure, extraction and condensing turbines for exact heat balance. Not only do the authors describe characteristics of various turbine types, they include performance data, calculation methods, correction factors and other pertinent information for preliminary estimating. Chapters on governors, generators, feedwater heating and an appendix of standard practices for turbine units are all presented in simple language without mathematics.

Electrical Instruments

MAINTENANCE AND SERVICING OF ELECTRICAL INSTRUMENTS (1944) *By James Spencer. Published by Instruments Publishing Co, 1117 Wolfendale St, Pittsburgh 12, Pa. 256 pages, 4½x8 in., 274 illustrations, fabricoid binding.* $2.

Because maintenance and servicing of electrical instruments has not previously been covered in a book, this one fills a real need. The author developed it from original notes for teaching the subject in trade schools and to new personnel of a manufacturing plant's instrument department. Operating principles of each type of electrical instrument in common use are first explained and then detailed instructions given on their maintenance and repair. Practical treatment makes the book useful to vocational school students, instrument users, switchboard attendants, test engineers and instrument service men and others interested in keeping electrical instruments in good condition.

Power Industry Future

THE POWER INDUSTRY AND THE PUBLIC INTEREST. *Published by the Twentieth Century Fund, 330 W 42nd St, New York, N. Y. 261 pages.* $2.

A factual review of relations between the public utility industry and federal-state regulatory bodies supplemented by a suggested program to be undertaken by all involved to protect the future of electric power service.

The original factual investigation was made by the research staff. On the basis of the staff findings, a committee of executives of utility companies, believers in public ownership and officials of regulatory bodies foresees continued extension of both private and public ownership of power facilities. This report makes interesting reading for all sides of the federal-municipal-private power controversy.

Electronics

PRIMER OF ELECTRONICS (1943) *By Don P Caverly, commercial engineer, Sylvania Electric Products, Inc. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 18, N. Y. 235 pages, 5½x8 in.; 124 illustrations; cloth.* $2.

Thousands of engineers and plant operators who have little or no knowledge of electronic devices are now finding themselves confronted with an ever increasing number for power and frequency changing, protective devices, lighting units, measurements, control and regulation, welding, light-sensitive equipment, counting, inspection and many other purposes.

This little book, written to help such men, begins with an answer to the question: What does *electronic* mean? Then it follows through with explanations of electronic phenomena and how they are produced, of electronic tubes, how they function, and their circuits. The work is divided into four parts: electric current, magnetism, electromagnetic radiation, and basic electronics. The latter covers electron tubes and many of the ways they have been used. Throughout the text the author religiously avoids mathematics and has presented his story in a practical, easy-to-read style, making it suitable for those short on technical knowledge but long on desire to learn more about electronics.

Electron—Optics

ELECTRON—OPTICS (1944) *By Paul Hatschek. Translated from German by Arthur Palme. Published by American Photographic Publishing Co, 353 Newbury St, Boston, Mass. 161 pages, 6x9 in., 125 illustrations, cloth,* $3.

Its title would probably cause most engineers to feel that this book was not intended for them. However, the reverse is true because optics are becoming a part of many electronic applications, such as measuring devices, electric-eye applications, lighting and others. This book is one that any one interested in electronic devices can read with profit. It was Dr. Hatschek's purpose to present the fundamental of electron optics in such simple form that it could be understood by many who had no previous acquaintance with the subject. In this he has been immensely successful, using plain language without mathematics. By attractive and ingenious methods of comparison he has linked a little known subject to a well-known one to make it understandable.

Biography

BELOVED SCIENTIST (1944) *By David O Woodbury. Published by Whittlesey House, a division of McGraw-Hill Book Co, 330 W 42nd St, New York 18, N. Y. 358 pages, 9½x6 in., cloth.* $3.50.

Publication of this gracious and distinguished biography of the great Elihu Thomson is a source of deep satisfaction to the editors of POWER because David O Woodbury, the author, was formerly news editor of this magazine.

(*Continued on page* 146)

Where Locomotives BELCH DESTRUCTION TO METALS

EVERDUR* STANDS UP

YEARS OF SERVICE in venting corrosive locomotive fumes from this railway loading dock have failed to impair the Everdur ducts in this San Francisco warehouse of the Atchison, Topeka and Santa Fe Railroad. Installation was made by the James A. Nelson Company, Inc.

Corrosion resistance, durability and workability combine to recommend Everdur for ducts, tanks and vessels that must withstand extreme conditions such as those encountered in chemical plants. Our Technical Department is available for assistance in meeting special problems. This service, of course, involves no obligation. 4461

*Reg. U. S. Pat. Off.

THE AMERICAN BRASS COMPANY
Subsidiary of Anaconda Copper Mining Company
General Offices: Waterbury 88, Connecticut
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ontario*

Everdur Copper-Silicon Alloys provide the corrosion-resistance of Copper . . . *plus these useful characteristics:*

High Tensile Strength—Everdur approaches the strength of mild steel.

Ready Workability — Everdur can be drawn, rolled, spun, stamped, forged and pressed . . . hot or cold.

Weldability—Everdur can be readily welded.

Everdur is made in practically all commercial shapes.

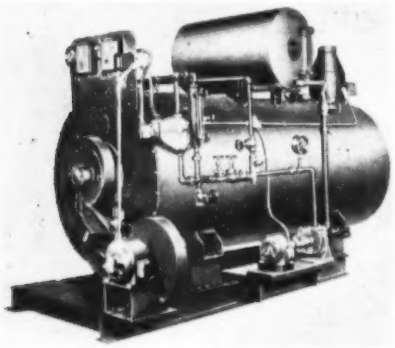
ANACONDA from mine to consumer

Anaconda Copper & Copper Alloys

WHAT'S NEW IN PLANT EQUIPMENT

Steam Boiler

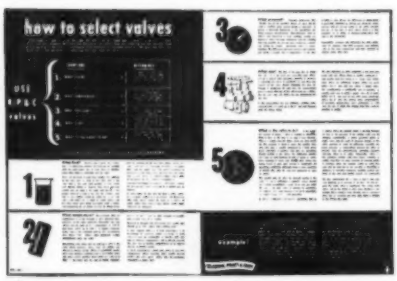
EXCLUSIVE FEATURES OF BOILER, which insure fast, effective and low-cost steam production, are said to be the following: (1) Its 3-pass construction provides quicker steaming, higher efficiency and longer boiler life. (2) Special oil burner gives a rotary motion to flame and as a result flame *hugs* combustion-chamber



walls, thereby assuring longer gas travel and greater heat transmission. (3) Built-in condensate-return system of O & S Powermaster unit provides compactness and easy installation. Return condensate, or water direct from supply line, or both, may be utilized as feedwater. *Orr & Sembower, Inc, Reading, Pa.*

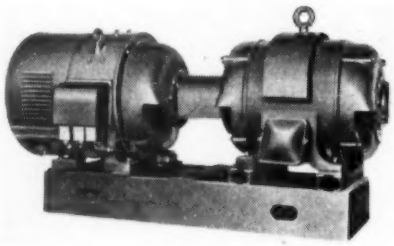
Synthetic Rubber Belting

FOR BELT REPAIR, join GR-S synthetic belting to natural rubber belting with a vulcanized splice. Company's standard splicing and repair materials may be used with new synthetic belting. *B F Goodrich Co, Akron, Ohio.*



Valve-Selection Chart

CHART GIVES A SIMPLIFIED BREAKDOWN of conditions to consider when selecting valves and an explanation of what these conditions determine in valve operation. Additional feature is the comprehensive explanation below the breakdown and also a typical application which uses facts brought out in chart for selecting correct valve for a specific condition. *Reading-Pratt & Cady div, American Chain & Cable Co, Bridgeport, Conn.*



Welding Mg Set

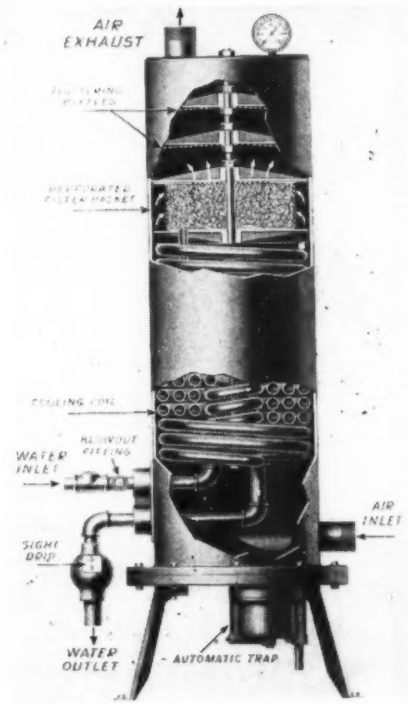
CENTURY AC-TO-DC MG SET supplies power for 15 to 30 men welding at same time. Squirrel-cage induction motor, with dipproof construction, is rated at 160 hp, 440 v, 60 cycle, 3 phase, 1160 rpm, one hr 50-C temperature rise. Motor drives a 70-v 1500-amp flat-compounded dc generator, rated one hr 50 C temperature rise. Machines can be operated in parallel when large quantities of power are required. *Century Electric Co, St. Louis 3, Mo.*

Oil Reclaimer

YM ROBOT OIL REFINERS, for cleaning lubricating oil with continuous and automatic operation, utilizes common refinery earths. It is said to remove fuel dilution, acids, solid and colloidal carbon, dirt and similar matter. It restores oil emulsified by water. Ability to restore transformer oils to 30,000-v dielectric strength is also claimed for this machine. A single reclaimer may serve an entire power plant. *Youngstown Miller Co, Sandusky, Ohio.*

Insulating Varnishes

SPEEDAIRBONDS are a group of air-drying insulators for electrical equipment. Varnishes give a high, glossy finish. They are oilproof and water, acid and alkali resistant. Company maintains that Speedairbonds give complete protection and insulation under adverse circumstances and against severe atmospheric conditions. *Sterling Varnish Co, Ohio River Blvd, Haysville, Pa.*



Aftercooler Separator Filter

AIR ENTERS BOTTOM of aftercooler separator filter at a full tangent, getting approximately 300 expansions with a whirling motion. Still whirling, it ascends in thin streams through interstices of wound water-cooled coil, which cools it. After being cooled, air passes through filter basket, then through fluttering baffles and leaves outlet clean and dry. ASF is best placed in line between air-receiver tank and distributing lines, to take advantage of precooling the air receives in tank and pipes, thus saving considerable water in cooling operation. The water may be run through ASF first, and, without the sight-drip valve, it may be conveyed direct to water jacket of air-compressor cylinder. In addition to aftercooler element, it has

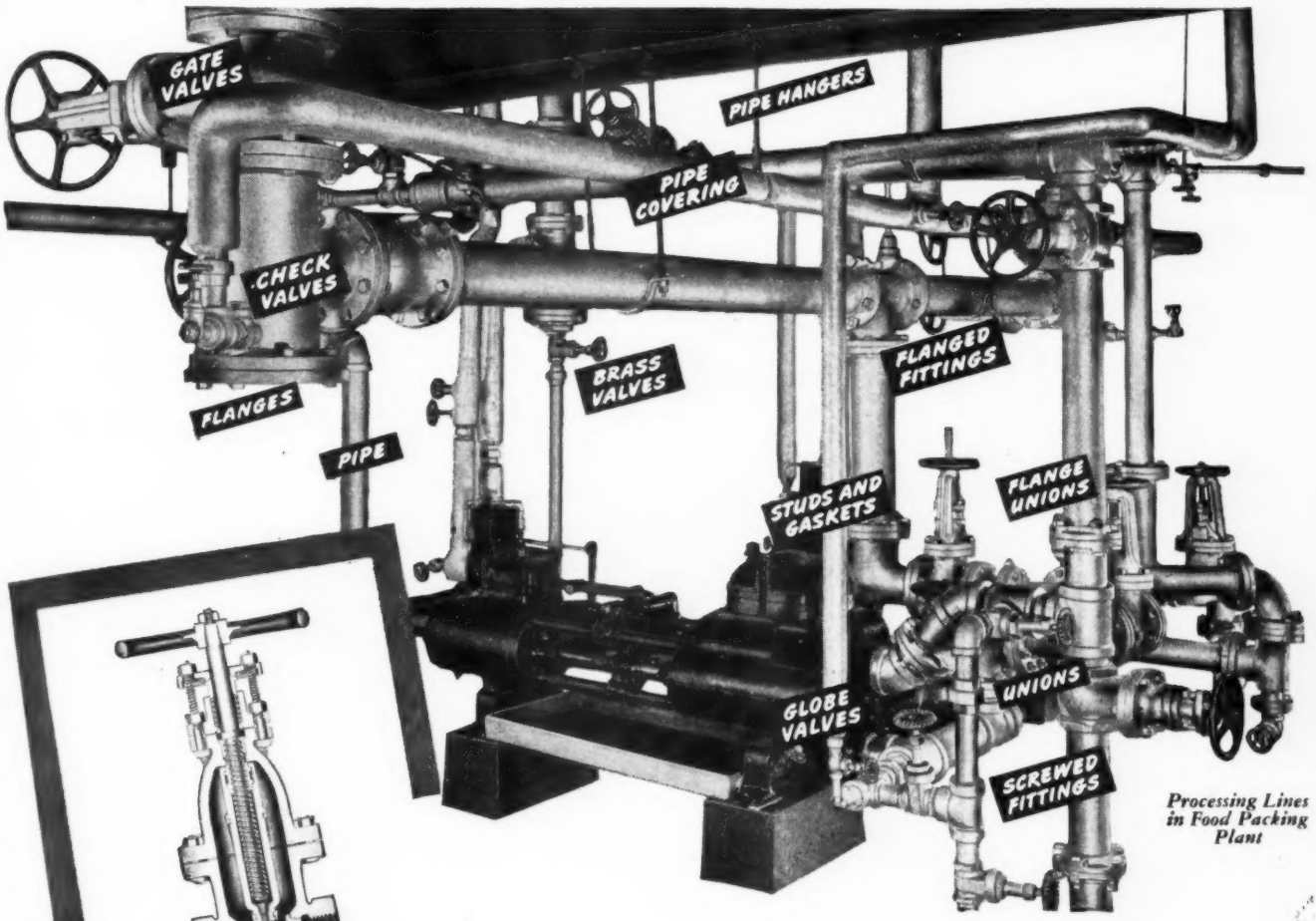
(*Continued on page* 168)

Anything for piping systems ...Crane can supply it

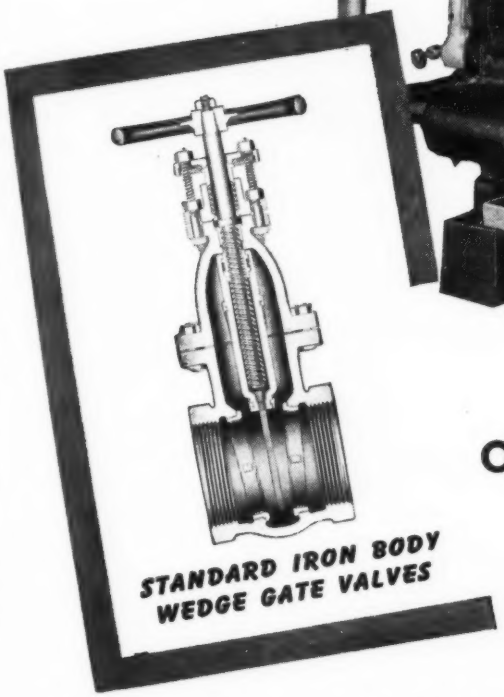
One Source of Supply . . . One Responsibility for All Materials

FROM single pipe fittings to complete piping systems, you stand a better chance of getting just what you need from Crane. For, at Crane you choose from the world's largest selection of brass, iron, and steel materials for every piping service.

In the installation below, for example, every item, pipe, valves, fittings, even studs, gaskets and insulation, are from Crane. Consider the advantages of this single source of supply—how it saves ordering time, simplifies maintenance and keeping of parts stocks. Consider the protection afforded by undivided responsibility for all materials—especially when that responsibility is backed by Crane Co.'s 89-year leadership in the piping field. Are you getting these benefits now? CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.



Processing Lines in Food Packing Plant



STANDARD IRON BODY WEDGE GATE VALVES

One standard of quality

The whole system is more dependable because of the adequate standard of quality in every part. Look at Crane Quality through Crane Iron Gate Valves. Stronger body design resists line strains. Port openings are straight through, giving streamline flow. A deeper stuffing box lengthens packing life. Adequate power in the stem gives positive seating, while extra long guides keep disc travel true.

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Watchword: Economy . . .

Twenty years ago, we were moving a big punch press. I snipped the leads from switch to motor—and our newest apprentice looked at me with dismay and disappointment. In his hand was a wrench, all set to loosen the connecting nuts.

"Why the look?" I asked.

"We could have saved that wire," he said. "I could have taken off the nuts, untaped the wire and straightened it out."

That called for an explanation. So we figured five minutes of my time, plus overhead, against a few inches of wire. He got the point.

But it's surprising how few of the men responsible for costs calculate such elements. Forget for the moment the shortage of materials, now rapidly easing, and consider the problem purely as one of economics. There are carpenter foremen who insist that a union man—at three or four cents a minute—stoop to pick up a dropped nail worth a fraction of a cent. If the buyer of a multi-thousand-dollar machine needs a replacement bolt, he may get it with a bill for a quarter or less. He pays it disgustedly—it costs the machine builder not only the customer's respect, but also about four times the face of the invoice to put it through his billing routine. Or the manufacturer of a household gadget sends out a demonstrator to show your wife how to use it—but charges a quarter for an instruction book that would save the trip.

I remember talking with a European power engineer shortly before the war. His idea of a plant was quite a bit different from mine—I thought in terms of saving labor; he was interested primarily in saving fuel. His labor was cheap and plentiful, but good fuel was expensive; in this country, the situation is exactly the reverse under normal conditions. After we got our viewpoints straightened out, we found our basic objective was the same—economy.

This is my whole reason for bringing up the subject—that we keep our viewpoints straightened out—because the time will soon be upon us when economy of labor will be the watchword again.

George Edwards
Engineer

DESIGNED ESPECIALLY for HIGH-SPEED CENTRIFUGAL PUMPS!

JOHNS-MANVILLE SPIRAL PLASTIC PACKING

HERE'S a tough pliable spiral plastic packing that's proven unusually successful in high-speed centrifugal pumps. It provides a tight-sealing bushing that operates with low friction.

Johns-Manville Spiral Plastic Packings are made of selected asbestos fiber combined with such materials as non-friction metal, graphite, mica, lubricants, and binding compounds. These materials are thoroughly mixed together into a homogeneous composition and formed into spirals of the proper density and uniform cross-section by extrusion through steel dies. Spiral Plastic comes in sizes of ¼" and up, any of which can be used for cutting rings to fit rods of various diameters.

A number of styles of J-M Spiral Plastic Packings are available, each designed for a particular use, such as No. 620 for oil, Nos. 640 and 645 for acid, No. 630 for food and Nos. 610 and 615 for general service. For more facts, write Johns-Manville at 22 East 40th Street, New York 16, N. Y.

Advantages of J-M Spiral Plastic Packing:

Easy installation — **Low friction**
Uniform density and cross-section
Each style compounded for a specific service
Eliminates need to stock many sizes of rings

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

THERE'S A J-M DISTRIBUTOR NEAR YOU

POWER NEWS

Washington Notes . . . Business Items . . . War and Postwar Pointers . . . Appointments in Power Field . . . Conventions

Power Engineers To Meet in St. Louis

National Convention of Power Engineers will be held August 22 to 25 at the Hotel Jefferson, St. Louis, Mo. In conjunction with it the National Power show will be held. Speakers will be national authorities. Invitations have been extended to all recognized engineering societies and several have accepted. Provision has been made for booths.

Plans were completed at a recent meeting in St. Louis when the photo below of national officers and members of Mo. No. 2 was taken: Left to right: Standing—Frank Laufketter, Tom Murphy, Herman Weber, Conrad Hemmersmeier, Frank Patton, Albert Froussard, A F Rieber, C E Chapman, Ferd Herr, Russell Loving. Seated—Jas A Whitmer, Chas Herr, Wm Warga, Stephen Gradl, J S Forman, Natl Secy A F Thompson, Natl Pres C A Bland, Natl Past Pres F C Laufketter, Natl Past Pres Stephen Castile, Pres Mo. No. 2 Eugene Bishop, Frank Velton, Forrest Henn, June Froussard.

Station Goes Places

A mobile substation can now be mounted on a standard railway flat car and taken anywhere on any railroad at a moment's notice. This high-voltage substation, designed by Westinghouse engineers, is entirely self-contained and meets requirements of the system on which it operates. It has all switching, transforming, distributing and protecting features of a modern stationary station, including a 3-phase transformer, high-voltage disconnecting switch, oil-circuit breaker, lightning arresters and a set of low-voltage switchgear. The latter comprises several feeder circuit breakers, control, and protective relay equipment. Main power transformer is shell construction with forced-oil circulation and air-blast cooling. The shell core, when laid on its side, provides strength and stability to withstand vibration and shock in rail transportation.

Two features—an ingenious turntable mounting for the high-voltage circuit breaker and a hinged collapsible structure for the high-voltage disconnecting switch—permit maintaining full electrical clearance between phases and to ground when substation is set up, yet, in transit, it keeps within railroad clearances.

Diesel Engineers' Third Wartime Meeting

Covering current problems of operation and design as well as recent developments that will influence internal-combustion engines of the future, the 17th National Oil and Gas Power Conference program, just released, shows a wide variety of interesting papers. The meeting will take place May 8-10 at the Mayo Hotel, Tulsa, Okla.

Current problems to be discussed include control for aviation, marine and railroad engines, governing of engine-generators in parallel, operation of pipeline stations, aircraft-engine maintenance and exhaust-system design. Looking to the future, other papers will cover gas-turbine prospects, turbocharging and design progress in gas-diesel engines.

(*Continued on page* 188)

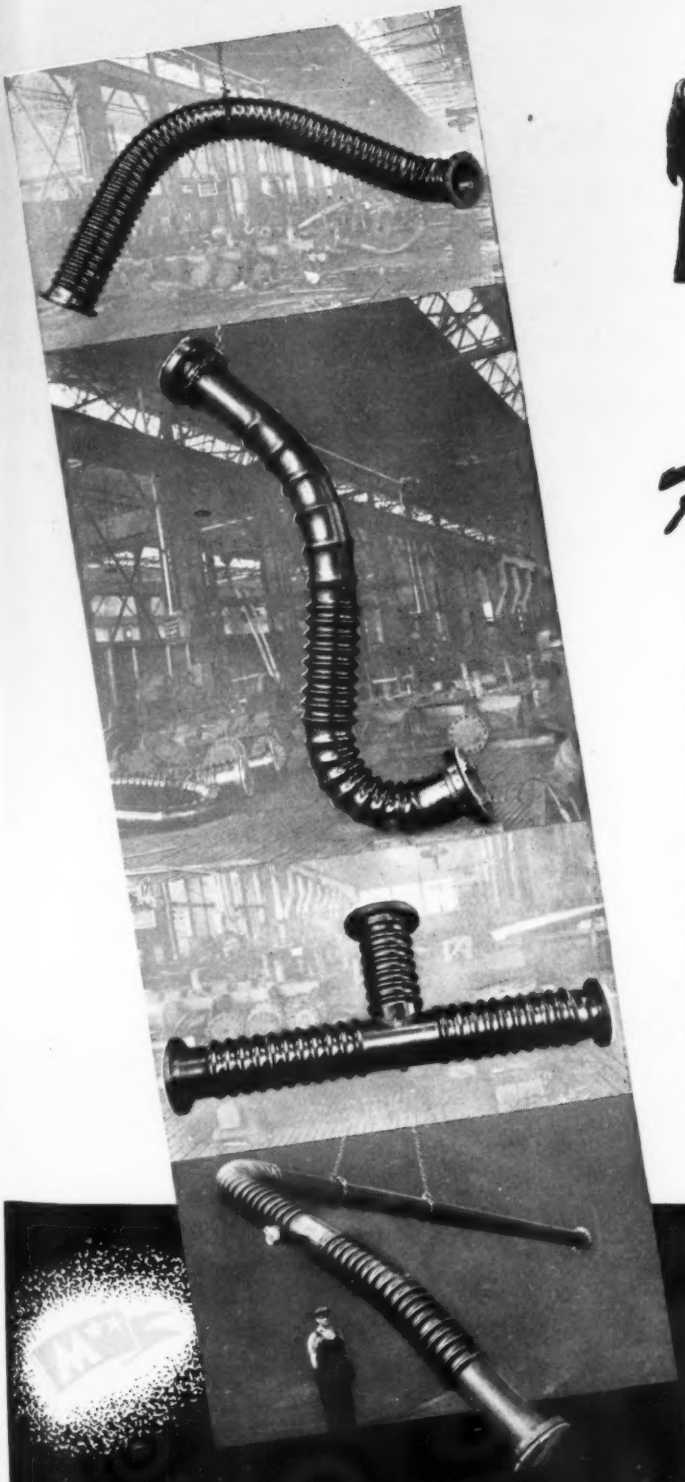
VERSATILE POWER PLANT. These engines will not only drive jeeps but will power radar equipment, floodlights, short-wave sets, searchlights, welding apparatus, landing barges, lifeboats, tractors, pump units, etc. More jeep engines are now harnessed to the United Nations' war effort than any other type of motor, Willys-Overland Motors revealed recently

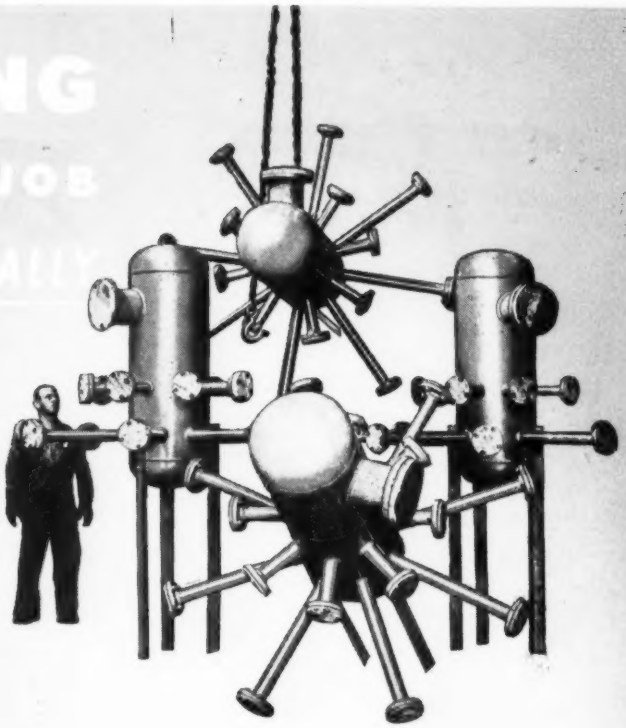
Hosts to Power Engineers at August Convention

KELLOGG PIPING

IS DESIGNED TO DO A JOB

CORRECTLY and ECONOMICALLY





KELLOGG prefabricated piping systems simplify piping problems because they conserve space—minimize joint stresses—provide safe connections to equipment unable to stand high forces or moments due to expansion—and give flexibility and complete reliability.

Many of America's central stations, process plants and marine power plants have successfully met war time emergency needs because the Kellogg piping was designed and prefabricated to provide sufficient flexibility and reliability.

KELLOGG

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricatiog Oil Plants. Plastic Refractories. Radial Brick Chimneys.

THE M. W. KELLOGG COMPANY

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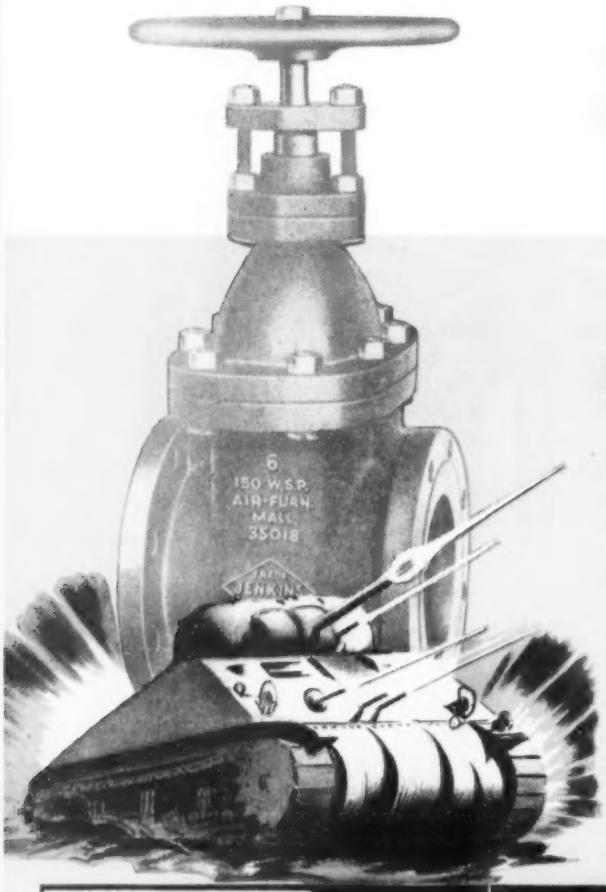
Representatives: LOS ANGELES: 609 SOUTH GRAND TULSA: PHILTOWER BLDG.

Now! Jenkins Valves of

Battle-Tested fo



Survive Valve-torturing Shocks and Strains!

Jenkins Air Furnace Malleable Iron Valves were developed for some of the most strenuous war services – to withstand severe strains, heavy blows, even the shock of nearby explosions. They are made from the same tough metal that has been battle-proved daily in U. S. war equipment.

Now available for industry, they offer *double* savings to plants that can use their exceptional features to advantage. As the chart indicates, they compare favorably with carbon steel in strength and impact resistance, yet they are priced substantially less. They save again by protecting the user against costly valve breakage and service interruptions.

COMPARE	TENSILE STRENGTH	SHOCK RESISTANCE		TEMP-ERATURE LIMIT	CORROSION RESISTANCE (Relative)	VALVE COST (Relative)
		YIELD POINT	ELONGATION IN 2 INCHES			
ASTM 126-30 CAST IRON	34,000 LBS. PER SQ. IN.	0	0	TO 450°F		
ASTM 47-33 AIR FURN. MALL. GRADE 35018	53,000 LBS. PER SQ. IN.	35,000 LBS. PER SQ. IN.	18%	TO 450°F		
ASTM 95-36 CARBON STEEL	70,000 LBS. PER SQ. IN.	36,000 LBS. PER SQ. IN.	22%	TO 750°F		

ONLY AIR FURNACE MALLEABLE MEASURES UP TO THE PROPERTIES SHOWN IN THE COMPARISON CHART

Don't confuse *Air Furnace* Malleable with other types of malleable iron. Top-rated grade is Air Furnace Standard Specification ASTM-47-33, Grade No. 35018 . . . the type used by Jenkins!

Meet U. S. Standards – Jenkins Air Furnace Malleable Iron Valves meet the standards of the United States Maritime Commission, and the Bureau of Marine Inspection and Navigation, United States Coast Guard.

High Corrosion Resistance – Air Furnace Malleable Iron Valves resist corrosion better than carbon steel or cast iron valves. This advantage, combined with high impact resistance, recommends these new valves for marine, petroleum, mining, and various chemical and other industrial services.

JENKINS VALVES

IR FURNACE MALLEABLE IRON

for Toughness

Save *Twice*--in First Cost--in Service Cost!

Next time you order valves for use where steam pressure does not exceed 150 pounds, and temperature is not above 450° F., check service conditions closely. If the valves will be subject to destructive shocks and strains, and if corrosive conditions are bad, consider Jenkins Air Furnace Malleable Iron Valves. There's a good chance they'll serve best and save most.

WRITE FOR BULLETIN NO. 192 on this complete new line of Jenkins Valves in the patterns illustrated here, sizes 2 in. to 6 in. Keep it in your Jenkins Catalog, it is sized to fit. Write to Jenkins Bros., 80 White Street, New York 13, N. Y.

Jenkins Bros., 80 White Street, New York 13, N. Y.; Bridgeport, Conn.; Atlanta, Ga.; Boston, Mass.; Philadelphia, Pa.; Chicago, Ill. Jenkins Bros., Ltd., Montreal; London, England.

Fig. 1105
Bronze Mounted Globe

Fig. 1109 Bronze Mounted Swing Check

Fig.1101
Inside Screw,
Bronze Mounted Gate

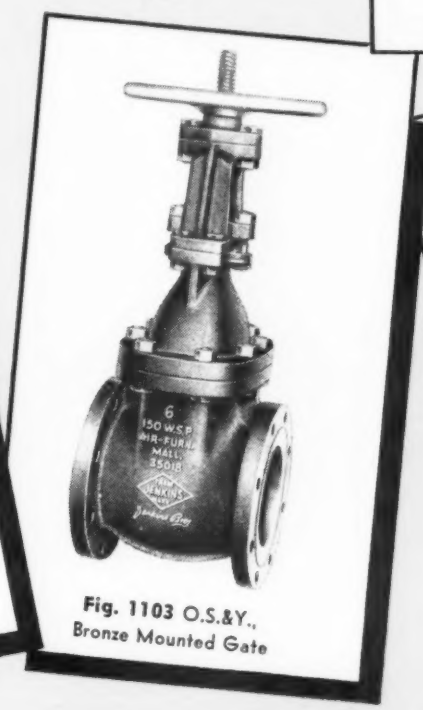


Fig. 1103 O.S.&Y.,
Bronze Mounted Gate

Fig. 1107
Bronze Mounted Angle

OR EVERY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING-HEATING SERVICE

BRONZE IRON STEEL

POWER'S DATA SHEETS

Number 141

Flowmeter Calibration Data

► A WATER COLUMN is generally used to obtain differential pressures when testing head-rate flowmeters. The meter's full-scale differential pressure in inches of water, if not marked on its name plate, can be found in its instruction book. These values for different meters are tabulated in the 100% columns, of the table below, on either side of the center column headed, Meter Manometer Differential, Inches of Mercury. Ratings of dry-calibrated meters are in the columns to the left of the center, and for wet-calibrated to the right.

To test a dry-calibrated 81.36-in. maximum-differential meter, find the value in the 100% column under "Dry Calibration." This value is the inches of water differential pressure required to deflect the meter full scale when dry calibrated and properly adjusted. For 50% scale deflection of this meter, differential pressure must be 20.34 in. of water. If wet calibrated, the meter requires 75.36 in. of water differential for 100% scale deflection and 18.84 for 50% scale range. Values in the center column are the inches of mercury deflection of the meter's manometer to give full-scale deflection of the meter.

HEAD FLOWMETER DIFFERENTIAL PRESSURES

Dry Calibration — Percent Meter-Scale Reading and Differential Pressure in Inches of Water										Meter-Manom Differential, In., Hg.	Wet Calibration — Percent Meter-Scale Reading and Differential Pressure in Inches of Water									
10	20	30	40	50	60	70	80	90	100		100	90	80	70	60	50	40	30	20	10
0.14	0.57	1.28	2.28	3.57	5.14	7.00	9.15	11.58	14.30	1.054	13.25	10.73	8.48	6.49	4.77	3.31	2.12	1.19	0.53	0.13
0.20	0.80	1.80	3.20	5.00	7.20	9.80	12.80	16.20	20.00	1.475	18.51	14.99	11.84	9.06	6.66	4.62	2.96	1.66	0.74	0.18
0.20	0.81	1.83	3.25	5.09	7.32	9.97	13.02	16.48	20.34	1.500	18.84	15.26	12.06	9.23	6.77	4.71	3.01	1.70	0.75	0.19
0.22	0.87	1.95	3.48	5.43	7.82	10.64	13.90	17.59	21.72	1.600	20.12	16.30	12.88	9.86	7.24	5.03	3.22	1.81	0.80	0.20
0.25	1.00	2.25	4.00	6.25	9.00	12.25	16.00	20.25	25.00	1.840	23.15	18.75	14.82	11.34	8.33	5.79	3.70	2.08	0.93	0.23
0.30	1.20	2.72	4.83	7.55	10.88	14.81	19.34	24.48	30.23	2.229	28.00	22.68	17.92	13.72	10.08	7.00	4.48	2.52	1.12	0.28
0.31	1.24	2.79	4.97	7.77	11.19	15.23	19.89	25.18	31.09	2.286	29.41	23.82	18.82	14.41	10.58	7.35	4.70	2.64	1.17	0.29
0.34	1.30	3.10	5.51	8.61	12.39	16.87	22.05	27.88	34.43	2.536	31.90	25.84	20.42	15.63	11.48	7.98	5.10	2.87	1.28	0.32
0.44	1.79	4.03	7.17	11.21	16.16	21.97	28.70	36.32	44.85	3.298	42.46	34.39	27.17	20.80	15.28	10.61	6.79	3.82	1.69	0.42
0.46	1.83	4.12	7.32	11.44	16.48	22.42	29.29	37.07	45.77	3.375	42.39	34.13	27.13	20.77	15.26	10.60	6.78	3.81	1.70	0.42
0.48	1.94	4.36	7.76	12.13	17.47	23.78	31.06	39.31	48.54	3.569	45.91	37.18	29.38	22.49	16.52	11.47	7.34	4.13	1.83	0.45
0.50	2.00	4.50	8.00	12.50	18.00	24.50	32.00	40.50	50.00	3.687	46.29	37.49	29.63	22.68	16.66	11.57	7.41	4.17	1.85	0.46
0.55	2.18	4.91	8.73	13.64	19.65	26.74	34.92	44.20	54.57	4.019	50.55	41.00	32.40	24.79	18.22	12.63	8.10	4.55	2.02	0.51
0.57	2.28	5.14	9.15	14.30	20.59	28.03	36.61	46.31	57.21	4.218	53.00	42.93	33.92	25.97	19.08	13.25	8.48	4.77	2.12	0.53
0.70	2.80	6.30	11.20	17.51	25.21	34.31	44.82	56.73	70.04	5.150	66.29	53.69	42.42	32.48	23.86	16.57	10.60	5.96	2.65	0.66
0.75	3.03	6.82	12.13	18.96	27.30	37.16	48.54	61.43	75.85	5.577	71.74	58.10	45.91	35.15	25.82	17.93	11.47	6.45	2.86	0.71
0.79	3.19	7.18	12.78	19.97	28.75	39.14	51.12	64.70	79.88	5.874	75.45	61.11	48.28	36.97	27.16	18.86	12.07	6.79	3.01	0.75
0.81	3.25	7.32	13.02	20.34	29.29	39.87	52.07	65.90	81.36	6.000	75.36	61.04	48.23	36.93	27.13	18.84	12.06	6.78	3.01	0.75
0.86	3.45	7.77	13.81	21.58	31.08	42.31	55.26	69.94	86.35	6.368	80.00	64.8	51.2	39.2	28.8	20.0	12.8	7.2	3.2	0.80
0.86	3.46	7.78	13.84	21.62	31.13	42.37	55.35	70.05	86.48	6.370	80.12	64.90	51.30	39.20	28.84	20.01	12.82	7.21	3.21	0.80
1.00	4.00	9.00	16.00	25.00	36.00	49.00	64.00	81.00	100.00	7.375	92.58	74.99	59.25	45.36	33.33	23.15	14.81	8.33	3.70	0.93
1.09	4.37	9.85	17.51	27.36	39.40	53.63	70.04	88.65	109.45	8.048	103.31	83.68	66.11	50.62	37.19	25.82	16.52	9.29	4.13	1.03
1.18	4.74	10.66	18.96	29.62	42.66	58.06	75.84	95.99	118.51	8.714	112.09	90.79	71.73	54.92	40.35	28.02	17.93	10.08	4.48	1.12
1.24	4.99	11.22	19.96	31.18	44.91	61.12	79.84	101.04	124.75	9.173	117.83	95.44	75.41	57.73	42.41	29.45	18.85	10.60	4.71	1.17
1.27	5.09	11.44	20.34	31.78	45.77	62.29	81.36	102.97	127.13	9.375	117.75	95.38	75.36	57.70	42.39	29.44	18.84	10.60	4.71	1.18
1.29	5.18	11.65	20.72	32.38	46.63	63.46	82.89	104.91	129.53	9.552	120.00	97.20	76.80	58.80	43.20	30.00	17.20	10.80	4.80	1.20
1.37	5.48	12.34	21.94	34.38	49.36	67.18	87.75	111.05	137.11	10.099	127.20	102.90	81.30	62.20	45.70	31.70	20.32	11.43	5.00	1.27
1.50	6.00	13.50	24.00	37.50	54.00	76.50	96.00	121.50	150.00	11.062	138.94	112.54	88.92	68.08	50.01	34.73	22.23	12.50	5.55	1.38
1.71	6.84	15.39	27.36	42.75	61.56	83.79	109.44	138.51	171.00	12.374	161.42	130.75	103.30	79.09	58.11	40.35	25.82	14.52	6.45	1.61
1.83	7.32	16.48	29.29	45.77	65.90	89.70	117.16	148.28	183.06	13.510	169.56	137.34	108.32	83.08	61.04	42.33	27.13	15.26	6.78	1.70
1.94	7.77	17.48	31.08	48.57	69.94	95.20	124.35	157.38	194.30	14.328	180.00	145.8	115.2	88.2	64.8	45.0	28 8	16.2	7.2	1.8
1.95	7.79	17.54	31.19	48.73	70.18	95.52	124.76	157.90	194.95	14.335	183.65	148.75	117.53	89.98	66.11	45.91	29.38	16.52	7.34	1.83
2.00	8.00	18.00	32.10	50.00	72.00	98.00	128.00	162.00	200.06	14.749	185.16	149.98	118.50	90.72	66.66	46.29	29.63	16.66	7.41	1.85
2.17	8.69	19.55	34.76	54.31	78.20	106.44	139.03	175.96	217.23	16.000	201.23	162.90	128.80	98.60	72.40	50.30	32.20	18.10	8.04	2.01
2.28	9.15	20.59	36.61	57.21	82.38	112.13	146.46	185.36	228.85	16.875	212.00	171.72	135.68	103.88	76.32	53.00	33.92	19.08	8.48	2.12
2.49	9.97	22.42	39.87	62.29	89.70	122.09	159.47	201.82	249.17	18.375	230.79	186.94	147.71	113.09	83.07	57.70	36.93	20.77	9.23	2.31
3.04	12.18	27.41	48.74	76.15	109.66	149.26	194.96	246.75	304.63	22.399	286.96	232.43	183.65	140.61	103.30	71.74	45.91	25.82	11.47	2.86
3.25	13.02	29.29	52.07	81.36	117.16	159.47	208.28	263.61	325.44	24.000	301.44	244.17	192.92	147.71	108.52	75.36	48.23	27.13	12.06	3.01
3.44	13.78	31.00	55.10	86.10	123.98	168.75	220.41	278.96	344.39	25.394	319.03	258.41	204.18	156.32	114.85	79.76	51.04	28.71	12.76	3.19
3.57	14.29	32.15	57.16	89.32	128.63	175.08	228.67	289.42	357.31	26.347	331.00	268.11	211.84	162.19	119.16	82.75	52.96	29.79	13.24	3.31

Compiled by W C Bennett, Cochrane Corp

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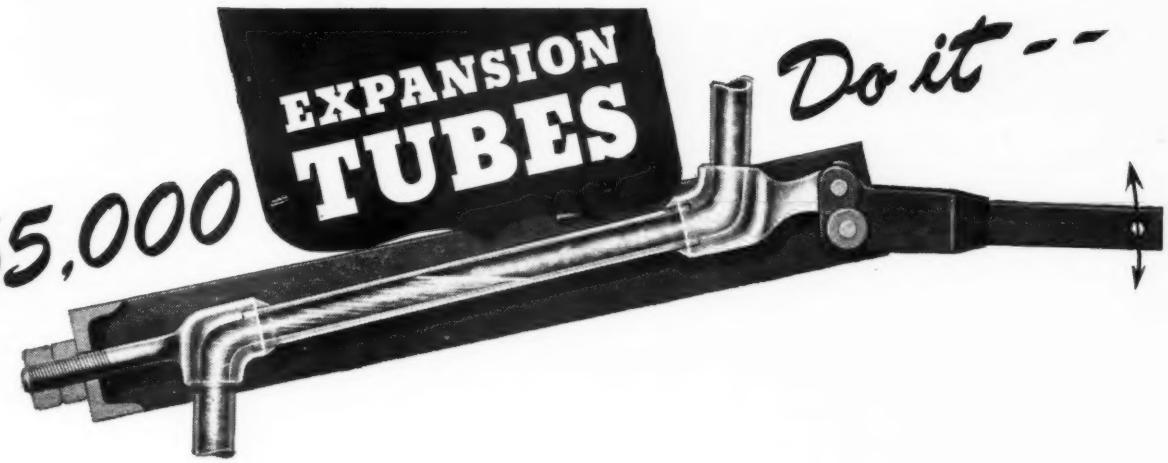
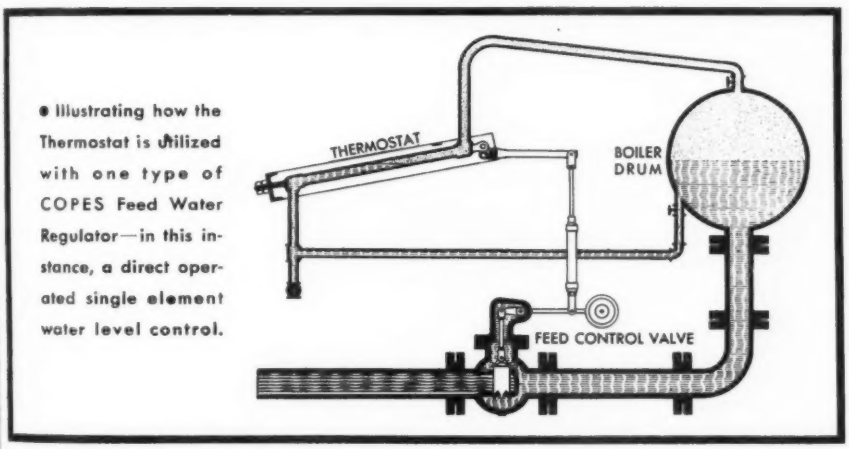
65,000 EXPANSION TUBES Do it --



THIS represents the COPES Thermostat—the boiler water level responsive element of more than 65,000 COPES Feed Water Regulators.

Aggressive research for 35 years has failed to uncover any other device as ideal for the purpose.

True, many mechanical improvements have been made. Frequently there are new adaptations to solve specific problems. Several styles are available for different types of COPES Regulators. But fundamentally the COPES Thermostat is still unchanged and unequalled.



• Illustrating how the Thermostat is utilized with one type of COPES Feed Water Regulator—in this instance, a direct operated single element water level control.

How It Operates

An inclined metal tube is mounted between two channels of a rigid steel frame. One end of the tube is anchored to the frame; the other end is attached to an angle type lever.

The interior of the tube is connected to the boiler drum similar to a water column, steam filling the upper part, and water the lower part. Corresponding water levels always exist in the tube and the boiler.

The water filled part of the tube is relatively cool due to radiation. Therefore when the water level lowers, permitting more hot steam to enter, the average temperature of the tube increases. The tube *must* expand. Conversely, with a rise in water level, the tube *must* contract. This movement, amplified by the lever, operates the feed water control valve either by direct mechanical transmission or by pilot valve fluid transmission.

Outstanding Advantages

1. SIMPLE. Just an alloy tube and lever. No floats, stuffing boxes, pressure chambers, liquid charges, fins, orifices, or concealed parts.

2. DEPENDABLE. Utilization of an unbreakable natural law without structural complication.

3. FULLY AUTOMATIC. Repeats performance continuously without periodic attention.

4. POWERFUL. Recall your own experiences with the tremendous forces developed by expansion and contraction.

5. RESPONSIVE. Grasp a pipe and shoot live steam into it. How quickly will you let go? Tests prove the COPES Thermostat responds to level changes 5 to 8 times faster than other devices.

6. ACCURATE. Minute changes in water level cause the tube to react as if by micrometer adjustment. All movement is transmitted smoothly with no lost motion, since working parts are kept in tension by weight or spring loading.

7. STURDY. Built to withstand use and abuse.

8. LONG-LIVED. Usually outlasts the boiler.

9. NON-FOULING. No fins to catch dust or dirt. Condensate keeps interior clean and scale free.

10. ADJUSTABLE. Nuts at the fixed end of the tube permit easy adjustment of water level setting *with the regulator in service.*

11. ADAPTABLE. Performs indoors or outdoors with climatic temperature from —40° to +110°F. Available in all pressure standards and several types to meet space requirements of any installation on land or sea.

Assures Superior Results

The superiority of the COPES Thermostat is just one important reason why COPES Feed Water Regulators provide the maximum of Safety and Economy.

Why not consider COPES for your boilers? A free survey, gladly made by our engineers at your invitation, may point the way to substantial benefits.

For detailed information on COPES Feed Water Regulators, write for Catalog 12-41.

NORTHERN EQUIPMENT CO.

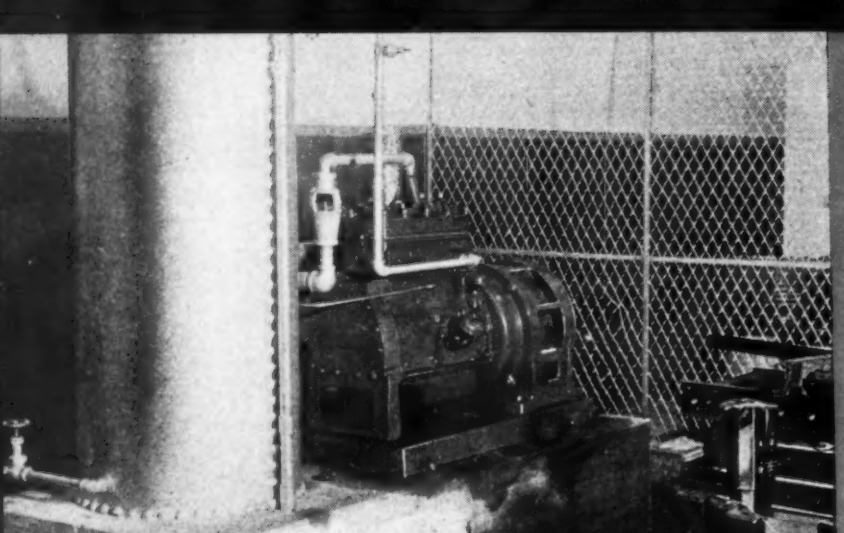
541 GROVE DRIVE • ERIE, PENNSYLVANIA

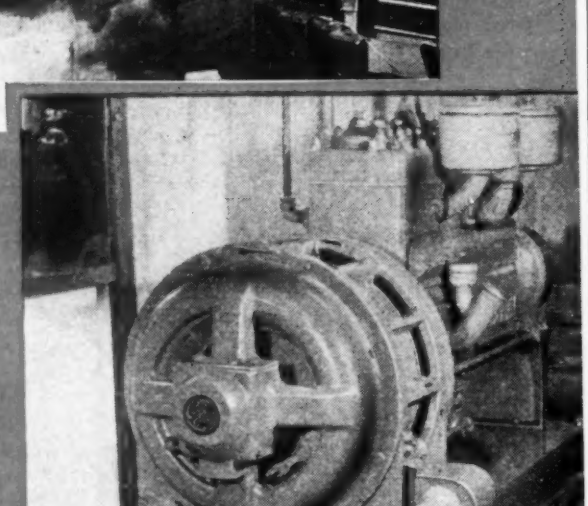
Feed Water Regulators • Liquid Level Controls
Pump Governors • Differential Valves • Reducing Valves and Desuperheaters

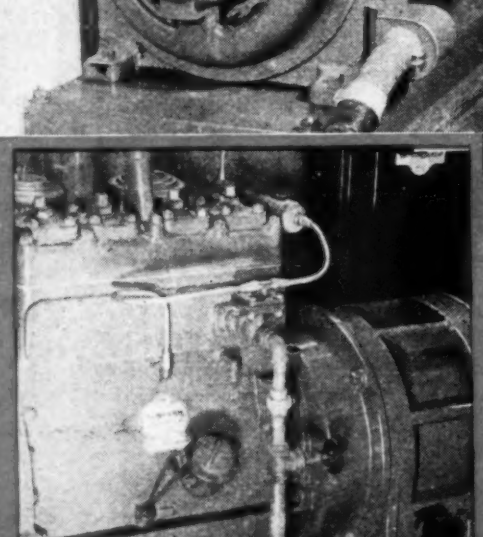
BRANCH PLANTS IN CANADA, ENGLAND
REPRESENTATIVES EVERYWHERE

COPES

Schramm Air Compressors







...for an endless variety of industrial uses

The rugged construction of Schramm's water cooled stationary air compressors gives them perfect balance — frees them of vibration and enables you to get air for any type industrial job.

Pictured here are three Schramm installations—each adapted to a different type job. This is only a small sample of their versatility, as they are installed in hundreds of plants throughout the country.

Schramm advantages: easily bolted directly to any substantial floor . . . compact to reduce headroom and floor space requirements . . . 100% water cooled to provide top efficiency both winter and summer.

Write today for illustrated Bulletin 42-S.

SCHRAMM INC

THE COMPRESSOR PEOPLE
WEST CHESTER
PENNSYLVANIA

Copper-Smelter Plant

(*Continued from page 67*)

there can be no interconnection at any point in water as well as in steam lines, except on the discharge side of boiler-feed pumps. Installation of four boiler-feed pumps to provide a standby pump for each deaerator has been justified by experience. The alternative of suitable crossover valving on the common boiler-feed pump-suction header was rejected as not safe.

We selected two motor-driven and two turbine-driven pumps, two of which are needed to feed the four waste-heat boilers, and a third to take care of a direct-fired boiler. All pumps normally operate at constant speed, although the two turbine-driven ones have oil governors and manual speed control for abnormally low loads. Bailey 3-element control governs boiler feed.

All makeup water comes from evaporators. When they operate, makeup water goes into the system and excess water is dumped normally as cold condensate into distilled-water storage tanks by manually operating a dumping valve. Failing this, discharge from the deaerator-tank pumps is throttled by a control valve operated by the deaerator storage level, or the deaerator overflow valve automatically discharges excess water into the distilled-water storage tanks.

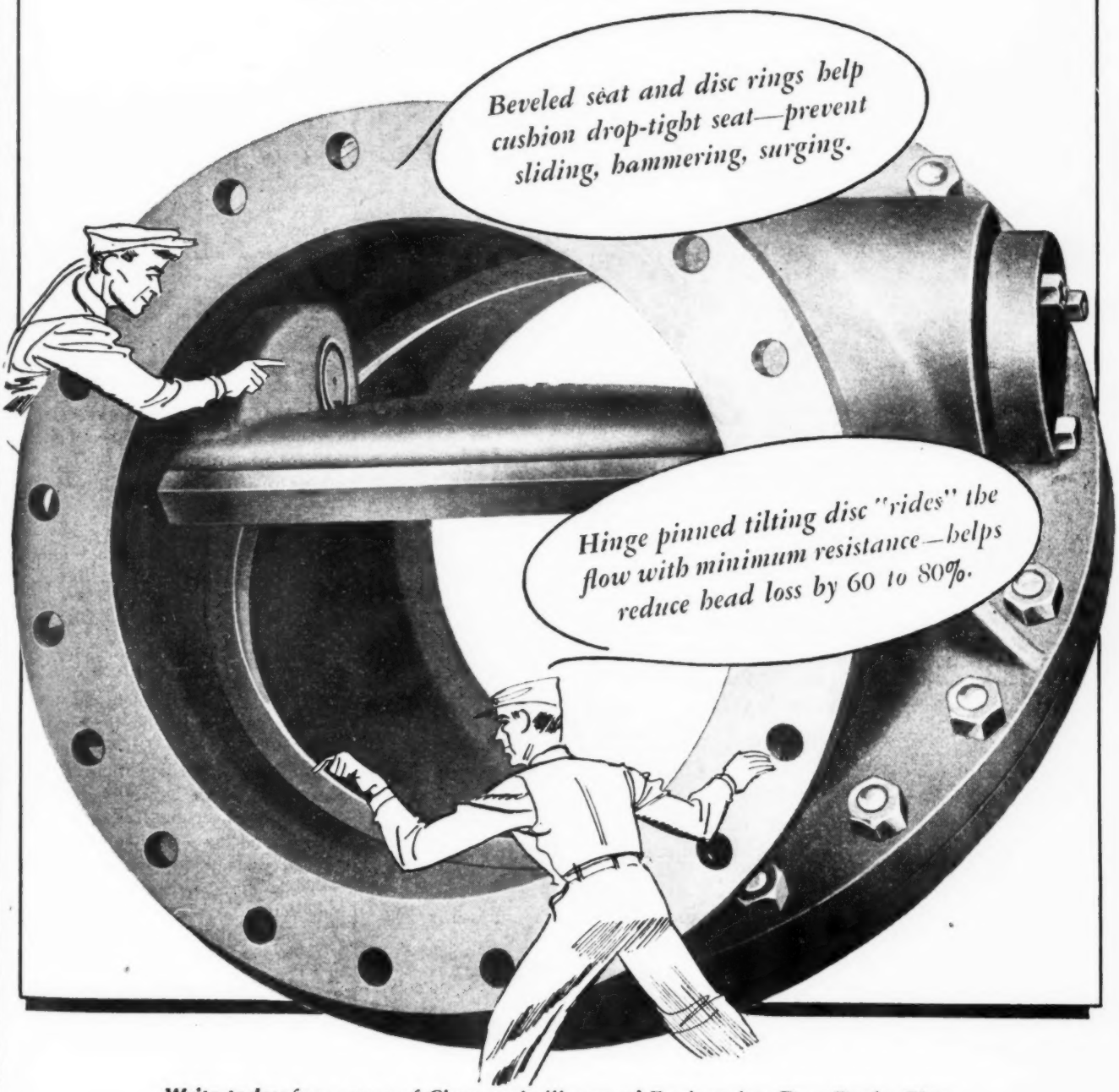
Makeup to Condenser

With the evaporators shut down, we add makeup water in the conventional manner by admitting it to the main condenser hotwell under influence of the condenser vacuum. For convenience, we arranged the makeup valve handwheel beside that of the dumping valve on the heater and pump-control board.

The turbine generators, with walkways around them, stand on reinforced concrete islands, fully independent of the building structure. For light, ventilation and access to mezzanine and ground floor, open wells are formed by omitting large sections in the operating floor.

Boiler- and turbine-operating floors are at the same level, with no curtain wall between. On centrally located panels are combined all boiler control and indicating, recording and control instruments for steam, turbine lubricating oil and generator air. In the pump bay, a heater board under constant attendant observation carries all indicating, recording and control in

LOOK WHAT
CHAPMAN'S AIRFOIL DESIGN
CAN DO FOR YOU!


Beveled seat and disc rings help cushion drop-tight seat—prevent sliding, hammering, surging.
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CHAPMAN NON-SLAM CUSHIONED CLOSING **CHECK VALVES**

Equally efficient on horizontal or vertical installations on water, steam, oil, gas and air lines

struments and gages for pumps and heaters in condensate, boiler-feed and distilled water systems.

All parts of the circulating-water pumps can be handled by turbine hall crane. Boiler feedwater, as well as heater-drain and condensate-booster pumps are arranged in a row on the ground floor of the auxiliary bay. A continuous crawl beam, with permanent trolleys and chain blocks above them, permits lifting pumps and drivers off their baseplate to floor or hand trucks, independent of and without disturbing other units or piping.

Circulating water to and from the cooling tower goes through spirally reinforced spun-concrete pipes laid under a cover of soil to protect them from the extremely hot sunshine prevailing all year. Their capacity provides for the power plant's ultimate capacity.

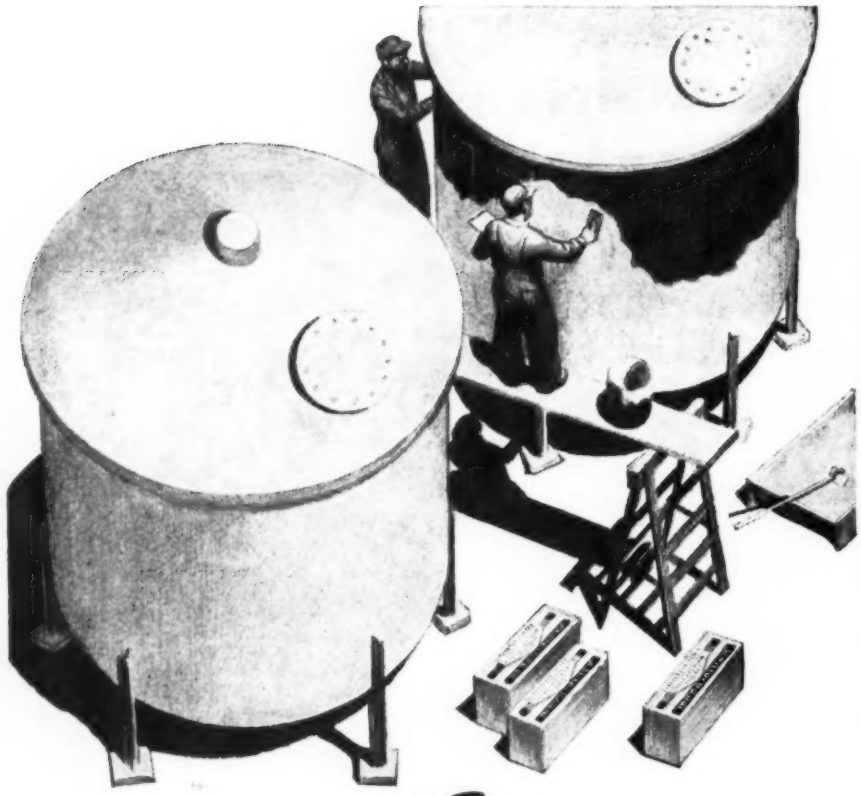
Initial installation consisted of four reverberatory waste-heat boilers in the smelter building; also three turbine-generators, two direct-fired boilers and one separately fired superheater in the power plant, besides compressors for low pressure and 90 psi air. On account of a reduction works extension of about 40%, four waste heat boilers, a fourth generating unit, also one more direct-fired boiler and another separate superheater have been added. For the additional units, the piping has been merely a duplication of that installed for the original equipment.

Steam Piping Flexible

In the power plant, an 8-in. steam lead runs from each boiler's non-return stop valve to a 14-in. manifold between the boilers and behind the separately fired superheater. Manifold also connects to the 10-in. line from the waste-heat plant, while an outlet is provided for an overcomer that leads to the manifold behind the second superheater. A second waste-heat steam line, originally provided for, now leads to the second manifold.

These manifolds are the mixing place for 660-F waste-heat steam and that coming from direct-fired boilers at about 750 F. All cutout valves on the manifolds are motor operated by a remote-control pushbutton station, but handwheels are within easy reach from a gallery.

Steam to main turbines flows from the manifolds through a direct-fired superheater, around each of which is a valved bypass. The manifolds also feed the steam line to auxiliaries, which forms a ring header, properly sectionalized by valves. On the deaerator floor, near the row of columns between boiler



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Made of *black* rockwool, Mono-block is high-temperature-resistant and has exceptionally low thermal conductivity. Long, straight fibres are specially interwoven in layers by an exclusive patented process that makes it lighter, more efficient. This means important savings, too.

Mono-block is easy to cut and easy to apply. Its felted surface yields to rivet-heads, welds, and other surface irregularities without cracking or breaking. Send for sample and new booklet. *Baldwin-Hill Co., 575 Klagg Ave., Trenton 2, New Jersey. Plants in Trenton, N. J., Kalamazoo, Mich., and Huntington, Ind.*

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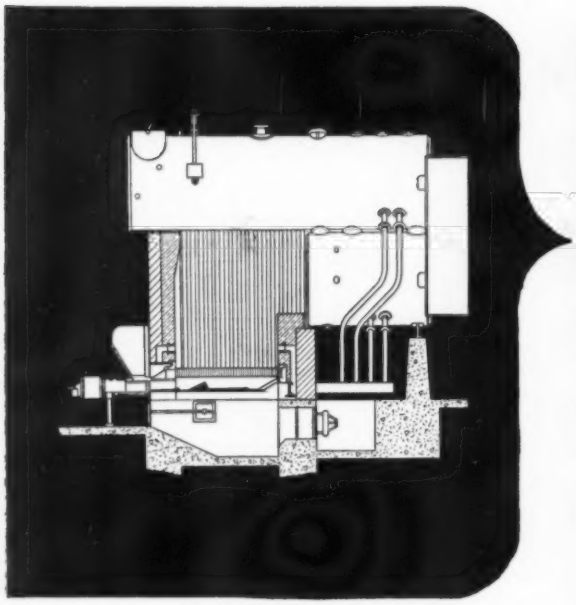

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A-TYPE

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BOILERS

PRESSURE VESSELS • PLATE FABRICATION

house and turbine hall, a short, anchored manifold for each turbine-generator makes all turbine steam leads alike. Turbine manifolds are interconnected by equalizing overcomers. Result is an extremely flexible piping system with remarkably low anchorage reactions. It utilizes out-of-the-way space without blocking aisles or access to major equipment. Spring-loaded hangers support most of the boiler-feed and blowdown piping. Main steam pipes use Genspring hangers.

An electric elevator with pushbutton control from all landings gives easy access to upper levels. Part of the electrical bay houses the main stairway, superintendent's office, laboratory, store room and locker room with toilet facilities. These features contribute to easy, comfortable supervision and operation with the smallest personnel.

A standard-gage railroad track runs into the west bay of the turbine hall and a 40-ton crane, having a 10-ton auxiliary hook, provides for handling all equipment in the turbine hall and on the mezzanine.

Shortly after the original plant was completed, an extension of 40% capacity of the Morenci reduction works was authorized. The extension has now been completed and all units are in successful operation, forming a well-balanced station as the result of careful plant layout at the beginning of this engineering job.

The Morenci power plant was built under supervision of Wilbur Jurden, chief engineer in charge of design and construction, Morenci Reduction Works, for the Phelps-Dodge Corp; electrical features were handled by S F French, electrical engineer.

The Old Chief

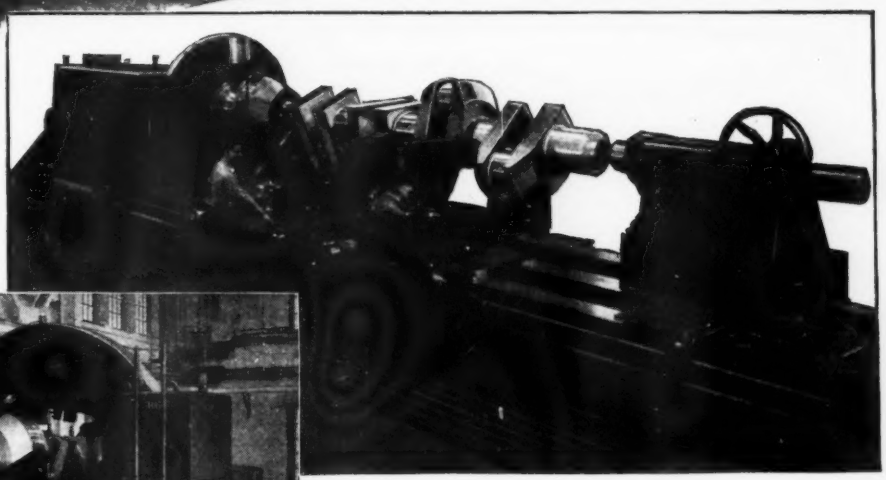
(*Continued from page* 94)

and his overshoes. I stepped back into the shadow so as not to embarrass Red in one of his soft, or real, moments. The old boy was saying something about being out of work a long time and assuring Red he would bring the clothes back.

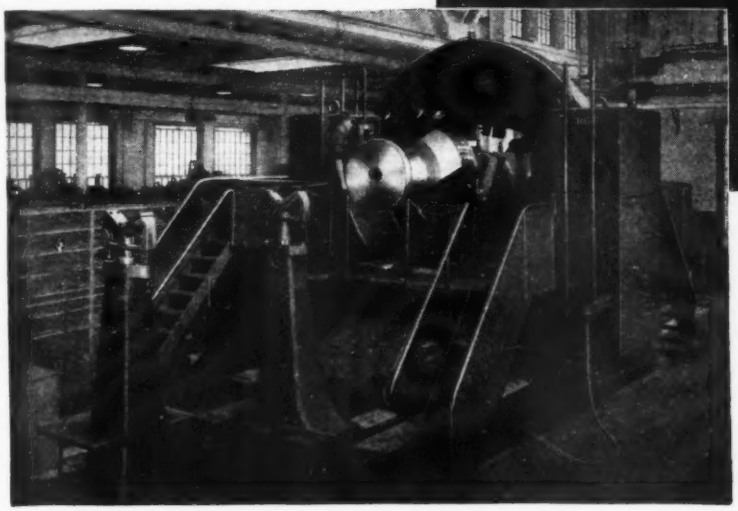
Then I heard Red's throaty voice. "Bring 'em back nuting, I was going to trow dem tings away, anyhow."

I watched Red go back to his work and thought that here indeed I had seen charity, the greatest of all virtues, in its most ample sense. I thought of a similar story that is related to us in the Big Book and wondered if this big fireman had not learned the implied lesson better than any of us.

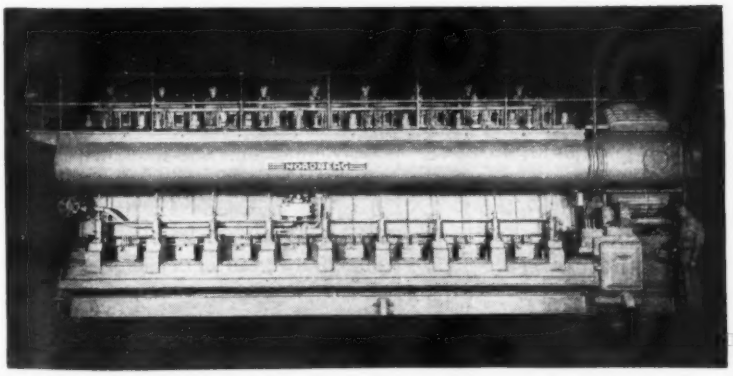
Facilities for building NORDBERG DIESELS



The largest crankshafts can be turned on this 84 inch lathe.



This 72 inch lathe for turning crank pins is one of the largest in this country.



Many of these nine cylinder 3600 horsepower Nordberg Diesel engines are in stationary and marine service.

These two lathes are typical of large and specially designed equipment installed by Nordberg for the building of Diesel engines. In addition to modern machine tool equipment and manufacturing facilities, there is that Nordberg experience — that "know-how" — which has been acquired through many years of building Diesel engines and other types of high grade power machinery. Plant facilities, trained personnel and experience now serving to produce Diesel engines for wartime needs will in the postwar period again provide the dependable and economical Nordberg Diesels required for peacetime needs.

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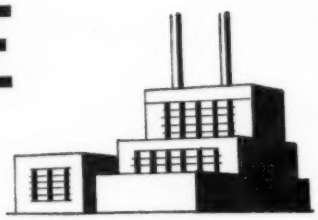


Present Indications Now Point To Ample Supplies

The addition of Monsanto Santosite to your boiler feed water will prove positive, low-cost insurance against oxygen corrosion. Power plants of all sizes have used Santosite over a number of years and with outstanding success.

Santosite protection is advisable even though you are using mechanical deaerating equipment efficiently. Oxygen, in small amounts, may get by the mechanical equipment and may get into boiler feed water because of overloads or leakage in the system. These small amounts of dissolved oxygen soon can add up to a dangerous total in the boilers.

Experience has shown that 30 parts of Santosite per million parts of water maintained *in the boiler* water gives efficient protection against oxygen corrosion. Santosite eliminates oxygen by combining with it, forming sodium sulfate. Both Santosite and sodium sulfate are soluble in water, therefore Santosite treatments leave no objectionable sludge.

Since Santosite is a stable, crystalline, anhydrous product, it is easy to handle and store. Standard chemical solution feeders can be used in applying it.

The amount of Santosite in boiler water can be determined easily by a simple chemical test of a type familiar to boiler room foremen. An upward trend in the Santosite requirements, shown by these tests, may be your first indication of leaks in the system or trouble developing in auxiliary equipment.

We shall count it a privilege to work with you in the efficient application of Santosite to your boiler feed water. For further details, please contact the nearest Monsanto office, or, write: MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri. District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Montreal, Toronto.

MONSANTO CHEMICALS

SERVING INDUSTRY...WHICH SERVES MANKIND

Diesel-Steam Plant

(*Continued from page* 100)

and take strain-gage readings on crankwebs. Pistons are pulled once a year and a full overhaul is carried out every two years. Based on less than a year's operation, the diesel-generator units have averaged 11.5 kwhr per gal generating about 335,000 kwhr per month.

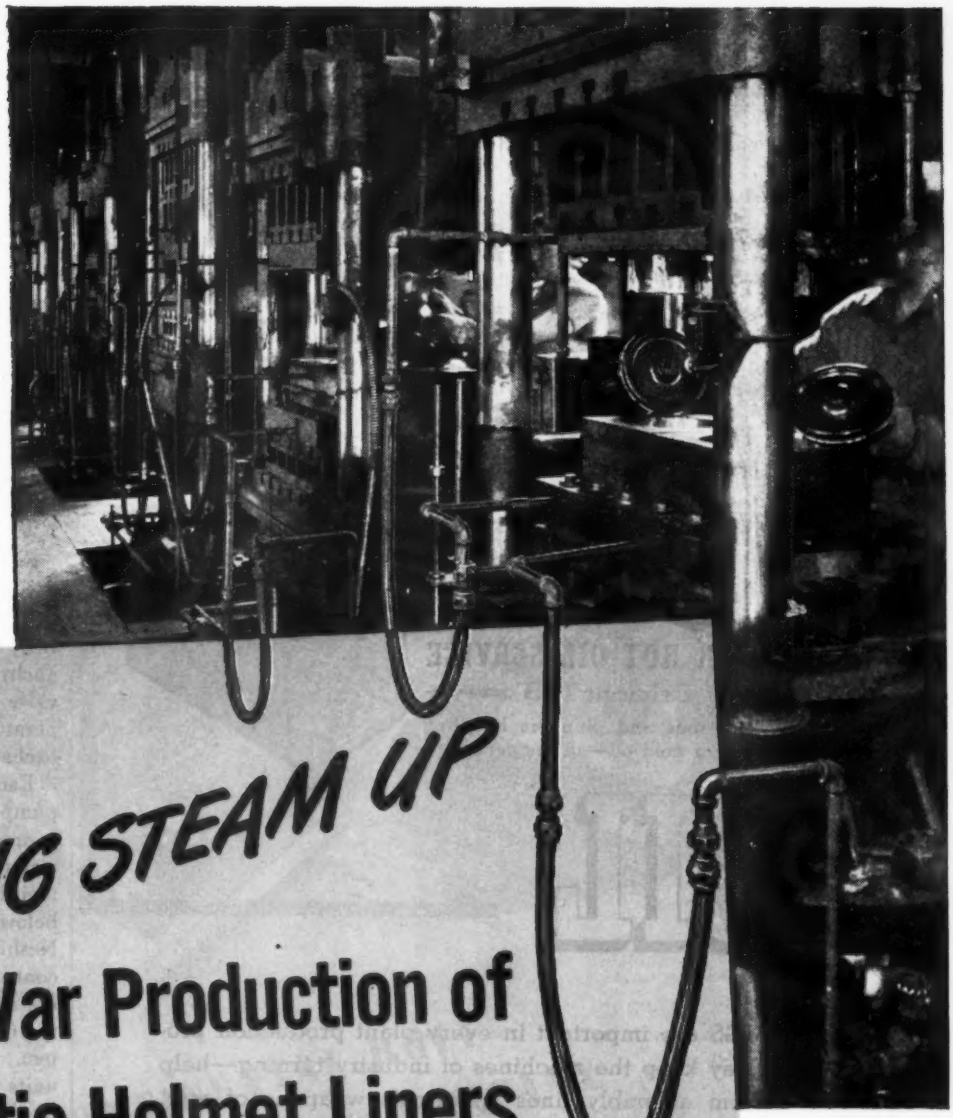
The boiler plant consists of seven 17,000 lb-per-hr 200-psi oil fired Cleaver-Brooks steam generators; they supply steam to heat exchangers which generate hot water for heating, air conditioning and process use. Built and shipped as "packaged" units, no erection was required except moving them into place and connecting piping and wiring.

Like the diesel fuel, No. 6 oil for the boilers arrives by either rail or truck, discharging by gravity to four 50,000-gal underground concrete tanks. Steam outlets at the fill pipes permit heating oil thickened in transit; steam heaters in the tanks maintain minimum storage temperature. Fuel flows by gravity from the tanks to a common header in the plant. A Viking fuel pump for each boiler takes suction from this header and pumps through a Davis steam preheater and an electric heater mounted on the boiler base. A regulating valve bypasses excess fuel back to the tanks.

Boiler Controls

Fuel then flows to the rotary-cup burner, which operates on a high-low flame principle, each line having a control valve. A forced-draft fan, driven by a constant-speed motor and fitted with damper control, takes care of pressure drop through the 4-pass internally fired fire-tube boiler, supplying all air for combustion. The stack merely serves to remove the products of combustion. Between high- and low-flame operation a control motor actuates the 2-position forced-draft-fan outlet damper.

Complete control equipment built into the boiler units permits virtually full automatic operation. A Minneapolis-Honeywell pressure control actuates a Barber-Colman valve controlling fuel flow, in accordance with steam pressure, and the motor for changing forced-draft-fan damper position. For double protection, Fenwal pressure switches and a Schaub float-operated mercury switch cut out fan and burner if water gets low. A Schaub high-and low-water control starts and stops the feed pumps. A Weston dial thermometer on the vent outlet gives a direct reading of stack



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Way back in the relatively calm days of '39, the Molded Products Company of Chicago were making radio cases for the pleasure of ordinary citizens. In May of that year they equipped one press with steam connectors of American Flexible Seamless Tubing. In September they equipped two more presses. In March 1940, under the pressure of war contracts, they equipped additional presses. And in July 1942, with the plant on 100 percent war production of helmet liners and plastic wheels for hand trucks, the remaining presses were given the added security of these steam-tight, free-moving, long-lived connectors.

The experience of the Molded Products Company is but one more instance of American Metal Hose going in on trial . . . *and coming out on top.* Wherever a practically indestructible, flexible, air-tight conveyor is required, for oil, gas, or water; for vacuum service or for protecting electric wiring, American Flexible Metal Hose and Tubing are providing reliability and economy.

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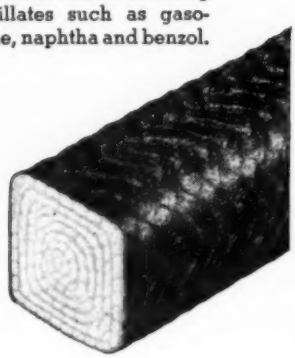
For rod and valve stems handling volatile distillates such as gasoline, kerosene, naphtha and benzol.



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Belmont 189 →

For rods and plungers handling hot or cold oil—all temperatures.

For OIL

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AND . . . now, when equipment must stand the strain of 24-hour-a-day operations—it's vitally important that just the right packings be selected for every job.

Above are two of the many Belmont Packings especially made for petroleum services. Both 6100 and 189 are made from asbestos yarn, braided and treated with suitable lubricants for maximum operating efficiency.

Any Belmont distributor (they are located in every large industrial center) will be glad to offer suggestions on your requirements. Or write on your company letterhead for a copy of the Belmont Packings Catalog displaying the complete Belmont Line.

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Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia

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BUTLER AND SEPVIVA STREETS • PHILADELPHIA 37, PA.

temperature and thus serves as a handy and accurate guide to tube cleaning. Experience indicates that the high-gas-velocity design reduces need for tube cleaning to about three times a year.

On each boiler unit, a Westco boiler-feed pump takes suction from a common header under the three 4500-gal condensate receivers. Blowdown discharges into two concrete tanks, one for each battery of boilers. Sump pumps dispose of blowdown overboard. There is a large drainage tank below the blowdown-tank level; if sump pumps fail blowdown can be dumped to the drainage tank. Boiler makeup, treated by Feedwaters, Inc, comes from the plant system—chlorinated well water.

Boiler steam at 200 psi flows through two independent mains to a battery of heat exchangers located in the main plant. Steam mains and return lines, from exchangers to condensate receivers, run in a reinforced concrete tunnel about 200 ft long. A Fulton-Sylphon valve regulates steam flow to hold temperature of water leaving the seven heat exchangers to 240 F.

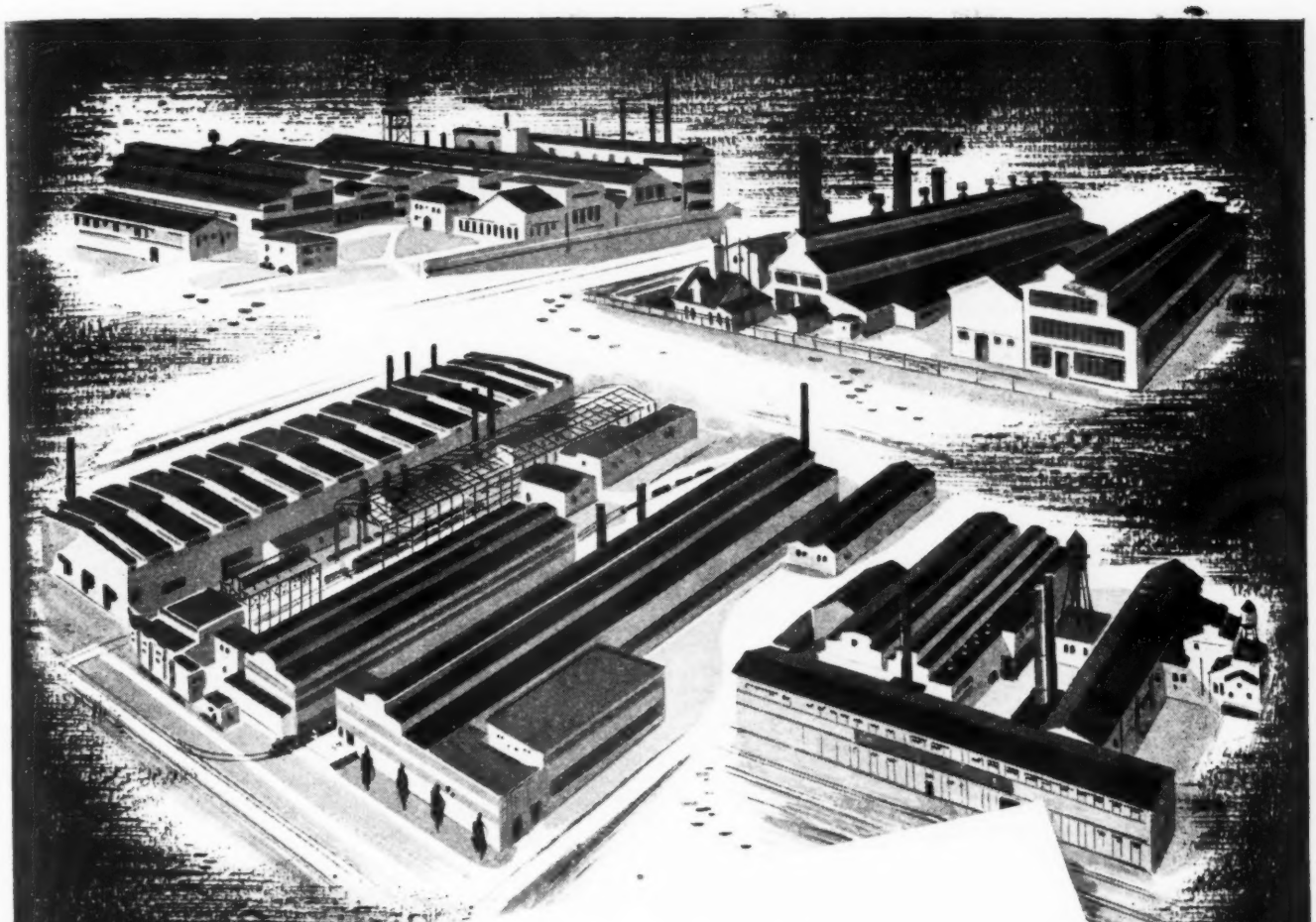
Each heat exchanger has an Aurora pump for water circulation; these hold a pressure of about 35 psi on the hot-water system. Makeup enters the system automatically when pressure drops below 26 psi. Hot water circulates to Nesbitt unit heaters with temperature-control valves, to Carrier unit conditioners and to preheaters and reheaters of the Carrier central air-conditioning system. Condensate from these various units returns by way of the tunnel lines to the three receivers mentioned.

Three large Webster-Nesbitt blower-fan unit heaters take care of winter loads in the power plant; in summer they serve for cooling. The intake-duct damper permits any mixture of fresh or recirculated air. Two Buffalo exhaust fans take care of power-plant ventilation.

The entire project, including the power plant, was designed by Ford, Bacon and Davis, Inc. General plant facilities supervision rests with H G Kenworthy, plant engineer. W F Leach is the operating engineer in charge of the power plant.

Correction

In the March, 1944, POWER, *"Choosing the Right Governor Isn't an Arbitrary Affair," in Fig.* 2, *page* 85, *the middle line now designated as "Governor position at rated position" should be changed to "Governor position at rated speed."*



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146 (347c)

Engineers' Books

(*Continued from page* 124)

A graduate of Massachusetts Institute of Technology, Woodbury is ideally equipped to interpret men of science to the world they serve so well and so modestly.

Elihu Thomson was a great man, second only to Edison as an inventor in this country, and far ahead of Edison as engineer and scientist. Yet, the writing of his biography was a difficult task for his life lacked those sensational elements that are the red meat of popular writers. Judged by the popular formula, such a man could not be a genius—but Thomson was. David Woodbury has made that fact amply clear.

Professor Thomson died at Swampscott, Mass., in 1934. Looking back over his amazing career, we find a list of 692 patents standing in his name, including such basic inventions as the 3-coil dynamo, electric welding, cream separator, ac distribution, the electric meter, repulsion motor, oil-immersed transformer, magnetic blowout, lightning arrester—also radical improvements in trolley-car and train control, in X-ray tubes, and in high-frequency radio equipment.

Any intelligent person can read this book with pleasure and profit, but it will appeal particularly to engineers, old and young, and to those young men who will become the great scientists and engineers of the next generation.

Diesels

DIESEL ENGINE CATALOG, VOL VIII. *Edited by Rex W Wadman. Published by Diesel Engines, Inc, 2 West 45th St, New York, N. Y. 400 pages, 10x13½ in., leatherette.* $5.

This volume describes in some detail the construction of 160 engines built by 49 American manufacturers, illustrated with photographs and sectional views of the units and of the more important component parts. The text outlines the various features of the design of each model and a series of summaries lists the cylinder size, speed and horsepower of each engine built by a given manufacturer and indicates the type of injection system and the nature of the service for which the engine is intended.

In addition, the catalog includes descriptions of five fuel-injection systems and of superchargers, blowers, magnetic couplings and hydraulic couplings.

Engineers interested in diesel engines should find this volume useful giving as it does a comprehensive picture of units available. It provides, in one place, information that could only be obtained by examination of a large number of engine-builders' catalogs.

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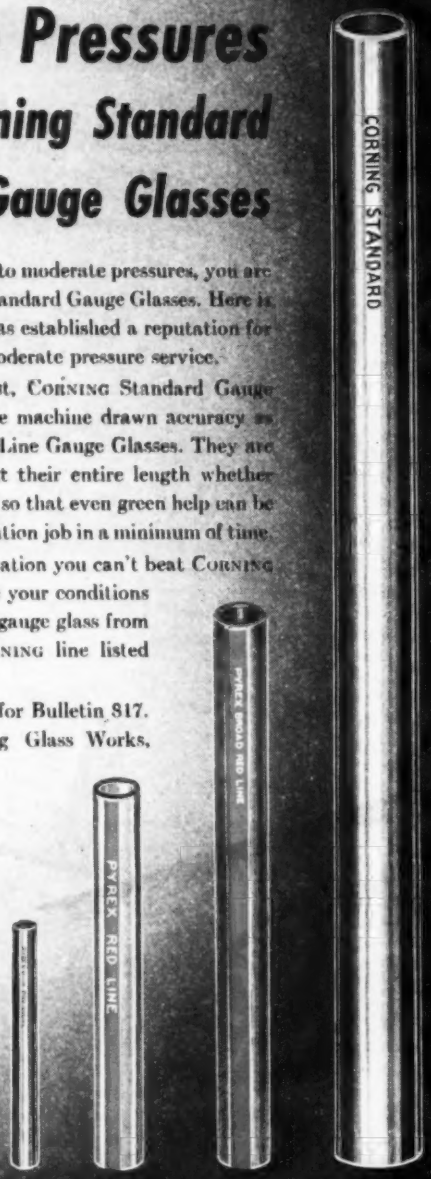
Want full particulars? Write for Bulletin S17. Industrial Division, Corning Glass Works, Corning, N. Y.



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CORNING Glass Works Corning, New York

Corning Gauge Glasses STANDARD

Float Control

(*Continued from page 73*)

varies between normal submergence and that required for the pump to pass the minimum quantity of condensate, plus recirculated water. Variation in this level, frequently appreciable, can be reduced by a larger recirculating line and valve to permit greater recirculation. Even with a large valve, hotwell level cannot be maintained as constant as with throttling control.

Use of condensate, for condensing steam in inter- and after-condensers or for cooling in oil coolers and generator-air coolers, requires recirculating control so that these auxiliaries receive at least the minimum condensate for satisfactory operation. They are placed in the discharge line between the pump and the recirculating line as in Fig. 2. Recirculating control gives the pump some protection from cavitation.

Pump Characteristics

Fig. 3 shows typical capacity, head and brake-horsepower characteristics of a pump with and without hotwell-level control. Rated condition on the pump, namely 100% capacity, head and brake horsepower, is obtained with 3-ft. submergence on its suction. System head curve is calculated for typical piping and auxiliaries, as installed in an actual plant. Head for any capacity on the system curve equals all losses in piping and auxiliaries beyond the pump, plus vacuum and static head at this capacity. If the pump develops its rated head at maximum quantity of steam condensed, then pump characteristic and system head curves cross at 100% rated capacity and head. This is the point where the pump operates when maximum quantity of steam is being condensed.

Assume that turbine load is reduced to where condensate flow to the hotwell drops to 45% full-load quantity. According to the system curve, head required to overcome all losses in discharge line, plus static and vacuum head ,is 53% of normal, point *E*. Here the pump requires only ¾-ft submergence and without a controller condensate level will automatically drop to this value; that is, pump characteristic head curve breaks down to meet that of the system. If flow to the pump is reduced further, submergence will drop lower until the pump head curve meets that of the system.

If we apply a recirculating controller,

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AND YOU CAN SPEND IT FOR THIS→
OR THIS →
A Steam Trap requiring 7 fittings to install
A Super-Silvertop Steam Trap Requiring one fitting to install

When considering the purchase of Steam Traps, it's your money that is being spent. You can select a trap requiring many fittings and the extra time to install them . . . or you can buy a Super-Silvertop Steam Trap that is installed straight-in-line or as an elbow requiring one fitting (in some cases two), and necessitating approximately an hour's less labor for each installation.

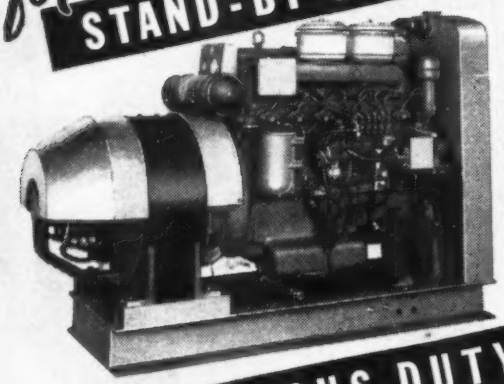
Which will it be? The decision is up to you. If there is a question of doubt in your mind as to what Steam Trap you should use, send for the book, "How to Choose a Steam Trap." It gives you complete, concise and detailed information on a Steam Trap to fit your particular job—it also points out the economies that can be made when you choose a SUPER-SILVERTOP STEAM TRAP.

THE V. D. ANDERSON COMPANY
1934 WEST 96th STREET · CLEVELAND 2, OHIO

Super-Silvertop
STEAM TRAPS

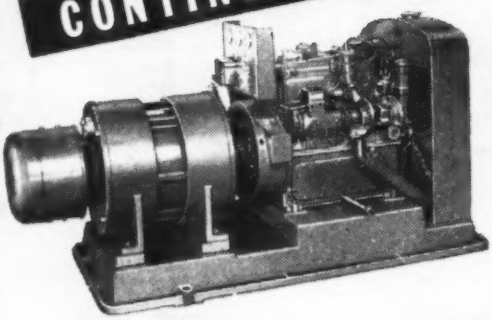
ELECTRICITY

for STAND-BY SERVICE



Serious losses as a result of prime-source power failures can be prevented by U. S. stand-by service installations. Units, either Diesel or Gasoline, range up to 75 KW. Write for details.

CONTINUOUS DUTY



For continuous duty, U. S. Electric Plants are built in the nation's most complete line up to 75 KW — Diesel, Gasoline, Kerosene, A.C., D.C., air-cooled, water-cooled,—for any type of application.

PORTABLE USES

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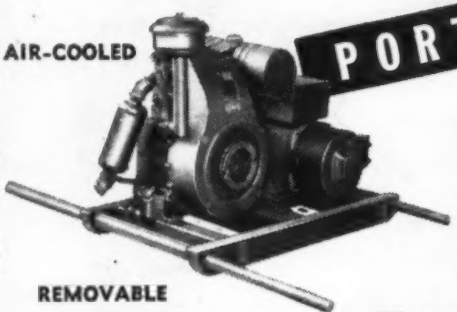

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This compact 2500 watt U.S. Portable (of which we have supplied the Army many) is an ideal unit for portable industrial use. Our portable line includes scores of other types and models. Write.

We can now supply various models on AA3 priority or better where production does not interfere with Army-Navy requirements.

UNITED STATES MOTORS CORP.
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U.S. Electric Plants
DIESEL and GASOLINE

it alters the required head-capacity curve of the pump. Assume that the controller maintains water level in the hotwell at 6 in. below normal, which in this case is 3-ft submergence, and that the controller valve can pass 50% of rated flow at 100% rated head. Capacity-head curve required from the pump is no longer the system head curve. Fig. 3, but curve OABD, and the pump operates as follows:

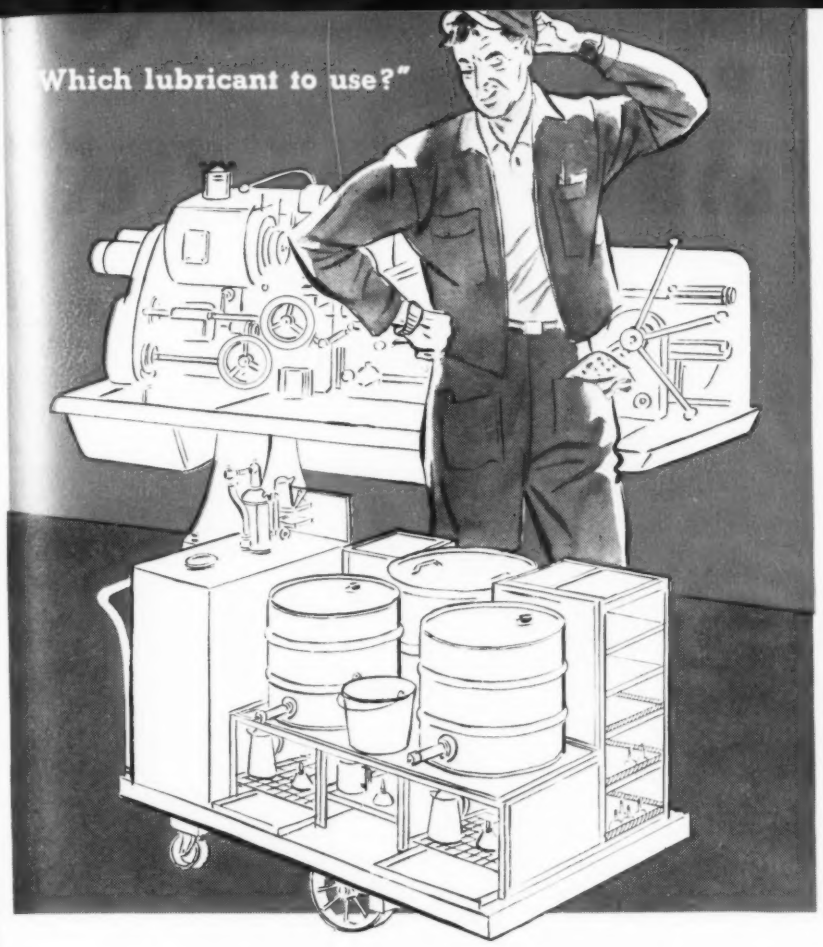
Pump Operation

1. When the turbine is started with a dry hotwell, all condensed steam flowing to the pump passes through the recirculating valve and the pump capacity and head gradually increase along the line OA. All condensate recirculates until point *A* is reached. Beyond *A* a portion of the condensate passes into the system. Once normal operation is established, pump capacity never drops below condition *A*.

2. With constant turbine load, pump capacity is fixed, being equal to quantity of condensate recirculated, plus steam condensed. If steam quantity condensed is small, the pump stabilizes along curve *AB*. If turbine supplies a relatively large load, hotwell level tends to rise beyond a 2-ft submergence point, where controller starts to close. Then the controller valve gradually closes and reduces the quantity of condensate recirculated. At point *D* the valve closes and the original system-head curve prevails. Maximum pump discharge with the controller open cannot exceed capacity *D*, because this point corresponds to maximum pump discharge at 2.5 ft suction submergence. Minimum pump discharge, other than when starting the unit, exceeds capacity *A*, depending on size of the recirculating lines and valve, pressure available to force water through the valve, and minimum quantity of steam condensed.

With recirculating control, hotwell level is not controlled below minimum float setting, which here is 2-ft submergence. Hotwell level adjusts itself to suction submergence required to maintain flow through the pump. If we maintain condensate flow from the condenser at 45% normal, then pump total discharge and head approximates the condition at *B* where suction submergence is nearly 2 ft. This is because 88% normal capacity through the pump, with recirculating controller operating, equals approximately 45% of normal condensate flow.

When using a throttling controller set for normal suction submergence as the condensate quantity decreases, the hotwell level drops and the throttling valve partly closes. A partly closed



Standard Coded Lubrication Service

. . . a definite answer to your oilers' question, "Which lubricant to use?"

The best lubricants and the most careful study of where and how to apply them are wasted unless the *right* lubricant is applied to the *right* spot every time it is needed. Worse than that, when lubricants are misapplied, machines may be damaged, time is wasted repairing them, and production drops off. The men in charge of your lubrication can tell you how troublesome this problem is in your plant—particularly today with new men on machines and oiler crews changing continually.

Misapplied lubricants have been as much of a problem to us as to you. For example, our Engineers may work with your plant men to determine the right lubricant for a certain troublesome application. It is found and works successfully for some time. Then trouble suddenly occurs—bearings go out, and a machine is tied up. Perhaps a new oiler was on the job—his instructions might not have been clear—or someone just "forgot" and the wrong lubricant was applied. But before the real cause is discovered—if it ever is—our lubricant is subjected to criticism and you waste time needlessly trying to find another.

Standard Coded Lubrication Service is our contribution towards solving your problem and ours.

The plan is briefly described at the right. Any plant is free to use this system or adapt it to its lubrication program. Plants in the Middle West, whether they use Standard Oil products exclusively or not, can get the materials needed, and the help of a Standard Lubrication Engineer in installing the service. Call the nearest Standard Oil Company (Indiana) office. Say you want to get more information about Standard Coded Lubrication Service. Or write 910 S. Michigan Ave., Chicago 80, Ill. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

How Standard Coded Lubrication Service works

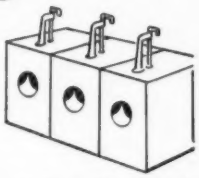
The first step in the plan is to assign code numbers to each lubricant used in the plant. Lubricants are simply numbered 1, 2, 3, etc. These numbers bear no significance as to type or grade of lubricant. Next, numbered decalcomanias (furnished by us) are applied to:

—every point of lubrication on every machine

—every grease gun or oil can used in servicing equipment

—every container or drum on your lubrication carts where they are used

and every barrel, drum, or storage tank in your oil house.



You can see at a glance that oilers merely need to follow the code number when filling dispensing equipment from storage, and in applying the lubricant to the right place, which is clearly marked to show that lubrication is needed and what number to use.

Machine Record Cards: Where desired, a supply of machine record cards is provided. The card or a copy of it may be kept in office files. This card shows the number of points to be lubricated, lubricants to be used, and lubricating schedules.

Lubrication Chart: For control purposes, a card is provided to list, by brand name and code numbers, all lubricants used in the plant. This card is used by stock clerk or stockkeeper to enable him to requisition products by brand name, and to mark barrels with the correct code numbered decal.

This Booklet gives full details of how Standard Coded Lubrication Service can go to work in your plant. Ask your Standard Oil Man for a copy. Talk it over with him and the men in charge of your lubrication. See how this plan fills a gap in your lubrication program.

Oil is Ammunition . . . Use it Wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

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Lubrication *News* letter

Practical suggestions from the field on how Lubrication Engineering and lubricants are being used by midwest operators to lick tough wartime jobs

MAY, 1944

Replacing a hard-to-get lubricant leads to many savings. A special high-temperature lubricant was used on the spinner bearings of an evaporator dryer. Temperature in the dryer was 300° F. The high-speed spinner operated at 12,000 r.p.m. Under these conditions, a good lubricant was needed for the anti-friction bearings. The product in use was expensive and hard to get. This led to a test of a Standard lubricant. With it, bearings got adequate lubrication—with 15% less consumption—at 50% lower cost—and the Standard Oil product used was available at a moment's notice to this Minnesota plant from the near-at-hand Standard Oil bulk plant.

Three old problems and two solutions. Electric motors in an aviation engine plant were operated almost constantly. They were a heavy-duty type and carried heavy loads. All ran excessively hot—that was problem one. Grease leaked freely from the overheated bearings, and bearing life was short—problem two. Finally, grease that leaked out got into motor windings which required frequent cleaning—problem three.

A Standard Lubrication Engineer was given the job of trying to cure the ills. He noted that motor bearings were equipped with grease fittings for grease gun lubrication. This type of application is desirable and entirely satisfactory where accurate schedules are developed, or provision is made for indicating the amount of lubricant fed to the bearings. The Engineer's solution eliminated the need for both measures. First, he recommended fittings be removed. Second, he suggested hand-packing the bearings with a highly stable grease—Stanobar No. 2. One particularly troublesome motor was used to make the test. After six months it was established that three problems had been solved. Bearings ran cooler, leakage was eliminated, and there were no bearing failures. Now all motors get the same treatment and give the same results.

Beats wartime, three-shift operation to the draw. As a routine precaution, oil was changed once a year in the hydraulic system of an extrusion press at a Detroit plant. That was in peacetime when equipment was operating one eight-hour shift per day. Then Stanoil was installed to see if oil change periods could be lengthened. But soon afterward the shift to wartime tempo in production struck this plant—three shifts per day, seven days a week. Under these new conditions, hydraulic oils had to stand more than three times the punishment—continuous heat, agitation, contamination, etc. But operating conditions made it necessary to keep Stanoil on the job a year. Then a sample was tested in the Standard Oil laboratories. It was reported to be in excellent condition—low acidity, good color, etc. This report, however, did not surprise the plant superintendent. He had already had a sample tested by an independent laboratory. Its report was even more favorable. Stanoil was still fit after more than three times the service which formerly required changing oil.

For the want of a nail, the battle was lost. There's an old story of the battle that was lost for the lack of a nail from the shoe of the general's horse. Here's the counterpart of that story—in reverse. A contract deadline was made because the right lubricant was found.

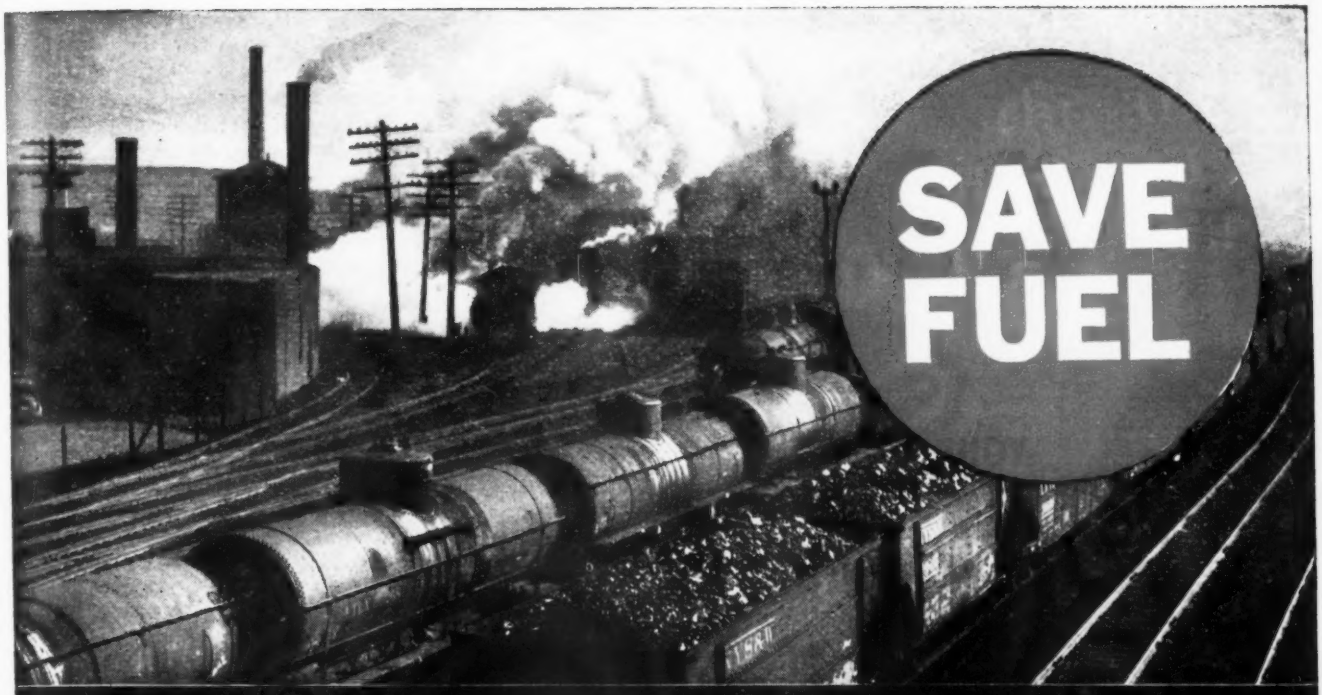
The contract called for producing a certain number of very large, and unnameable, units in 105 days. A big horizontal milling machine was the bottleneck. It produced a comparatively small but important part of the unit. If the machine could be speeded up 10%, the part could be made, and the units completed within the time limit. But the manufacturer had had trouble with a worm gear on this machine. It usually had to be replaced after a 30-day run. He hesitated to increase the speed of this machine because of the excessive wear and frequent shutdowns that might be necessary.

When the problem was explained to a Standard Lubrication Engineer, he recommended Stanogear 6X. After a 30-day run, which was the average life of the worm gear, an inspection was made, and no appreciable wear was found. This saved a 24-hour shutdown for replacement. Production was resumed, and another run of 70 days was made without repairs. The contract was completed in 100 days.

See your Standard Oil Lubrication Engineer. One of these Engineers can help you find the answer to your difficult lubricating problems. Call the nearest Standard Oil Company (Indiana) office, or write 910 S. Michigan Ave., Chicago 80, Illinois, for his help. In Nebraska, write Standard Oil Company of Nebraska at Omaha 2.

Oil is Ammunition . . . Use it Wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE



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When Maxim Heat Recovery Silencers provide steam or hot water for heating or processing purposes *no extra fuel is used.* The source of heat is simply engine exhaust gases normally wasted. In nearly all cases it is necessary to silence the exhaust outlet and Maxim Heat Recovery Silencers provide this necessary silencing plus the very important saving possible through the production of usable steam or hot water without additional fuel cost.

As a matter of operating efficiency this is obviously good practice at any time, but in wartime the possibility of conserving fuel takes on even greater importance.

Maxim Engineers will be glad to discuss the application of Heat Recovery Silencers to your Specific problem. Descriptive Bulletins WH-100, WH-102 and WH-103 will be sent on request.

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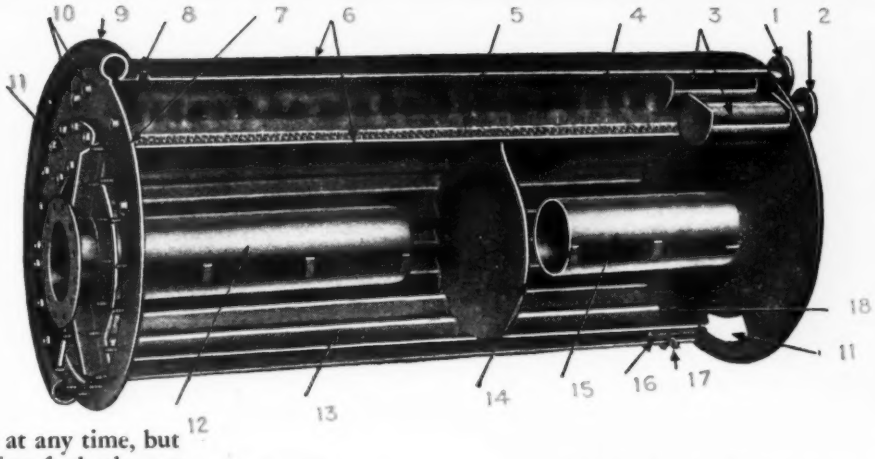
Maxim Silencers without the heat recovery feature are available for effective silencing of internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request. Please give details.



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13—Extended Heating Surface—forming conduits for leading exhaust gases from one attenuating chamber to the other
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15—Outlet Bleeder Tube
16—Feed Water Deflector Plate
17—Feed Water Connection
18—Exhaust Gas Outlet from side conduits formed by extended heating surfaces

THE MAXIM SILENCER CO.
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ARMY E NAVY

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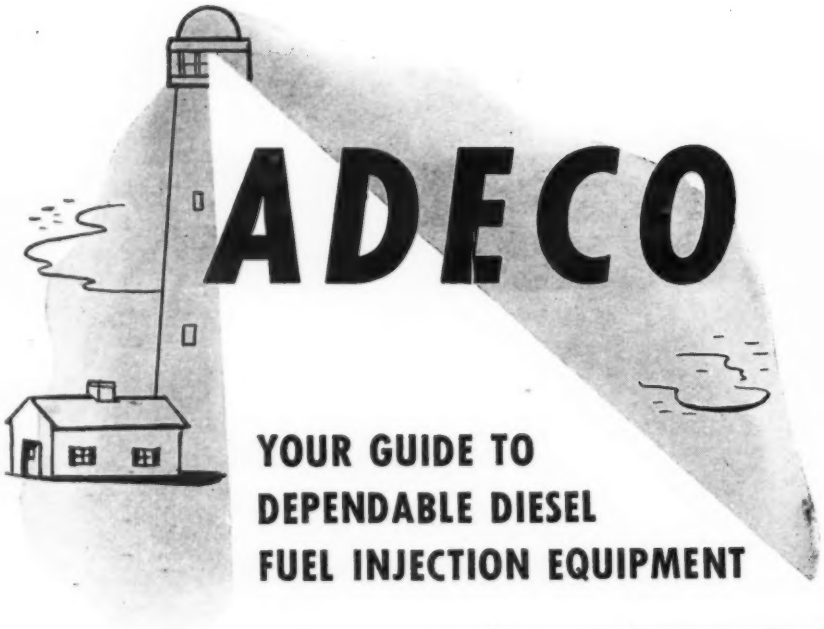

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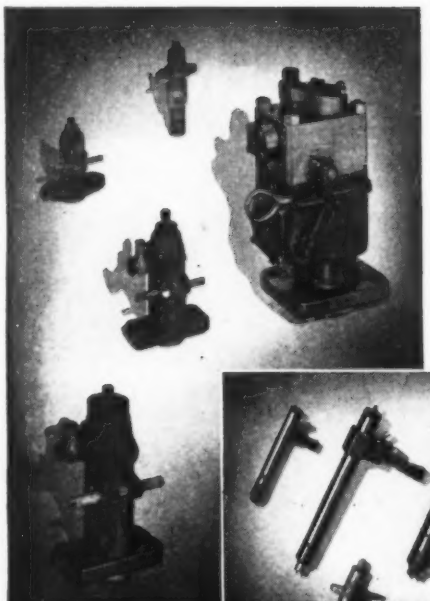
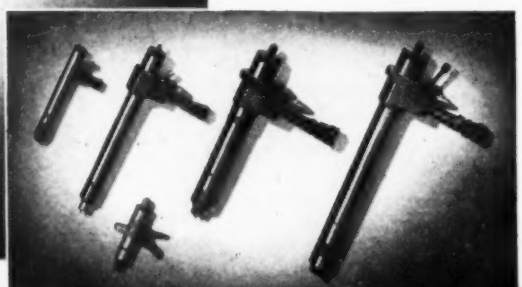
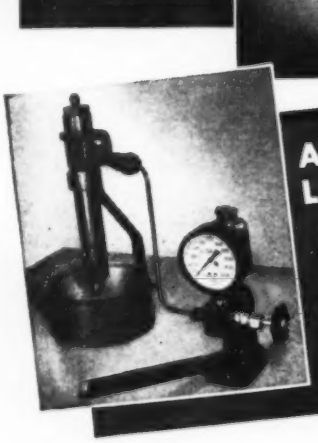
Today, more than ever, it will pay you to look to Adeco as your guide to dependable fuel injection equipment.

Every Adeco fuel injection pump, nozzle and nozzle holder reflects the long experience in precision design and workmanship gained through years of pioneering and research for the diesel industry.

There's a wide range of standard equipment to meet your most exacting needs.







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America's most widely used Nozzle Tester enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Compact, portable, sturdy, precision-built. Pressure up to 10,000 p.s.i. Tests both large and small injectors. Avoids costly delays and possible damage to engine. Also obtainable with Navy-approved gauge. Write for new bulletin.

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valve creates a friction loss in the system equal to the difference between system head curve and pump capacity-head curve. Head developed by the pump, therefore, equals that shown on its head-capacity curve corresponding to its discharge rate at a given instant. Minimum hotwell level with this arrangement corresponds to the minimum float setting. If a float set to maintain 3-ft suction submergence has a travel of 6 in. down, then minimum hotwell level will be approximately 2.5-ft submergence. If condensate flow to the hotwell drops to 45% normal, which corresponds to 88% normal pump capacity, then the suction submergence would be between 2.5 and 3 ft and pump head would be 103% of normal, point F. With more than pump-rated suction submergence available, if the controller were set at the highest submergence, say 4 ft, Fig. 3, the pump would operate near point *C* and its power, point *G*, would exceed 100% normal and might overload the motor.

Total Pump Head

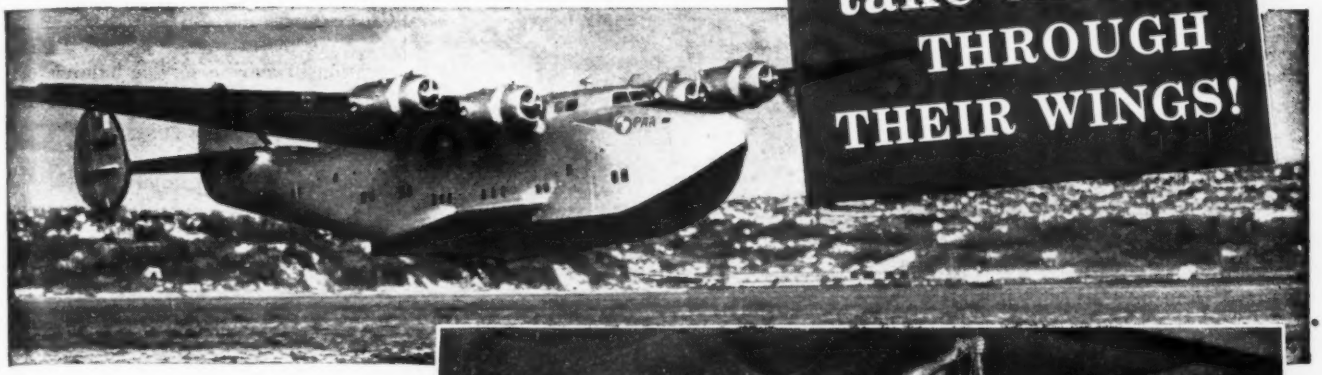
As can be seen, total pump head is different for the different systems of control. For a given flow from the condenser, if no control is used, pump head equals system head. With a throttling controller, the head equals that shown by the pump capacity-head curve. With a recirculating control in operation, head for pumping the quantity condensed, plus the quantity recirculated, is on line *AD*. For a given quantity of steam, condensed head on line *AD* is higher than the system head. This is because a portion of the discharge piping and auxiliaries are passing not only all the steam condensed but also recirculated condensate, with a corresponding increase in friction loss.

A combination of recirculating and throttling control may be used to eliminate effects of cavitation and insure maintaining an ample flow through the auxiliaries. The control arrangement is then a combination of that in Fig. 1 and 2. The throttling control valve is installed in the pump discharge line beyond the recirculating-line connection. Advantages and disadvantages of using both controls are a combination of those enumerated for each of the two methods in the table.

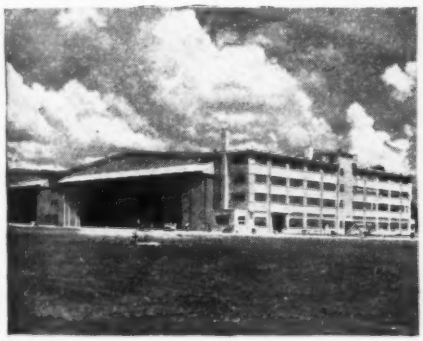
The 1943 Lamme Medal, AIEE, has been awarded to Arthur H Kehoe, vice-pres. Consolidated Edison Co of N. Y., Inc, for pioneer work in developing ac networks and associated apparatus for power distribution.

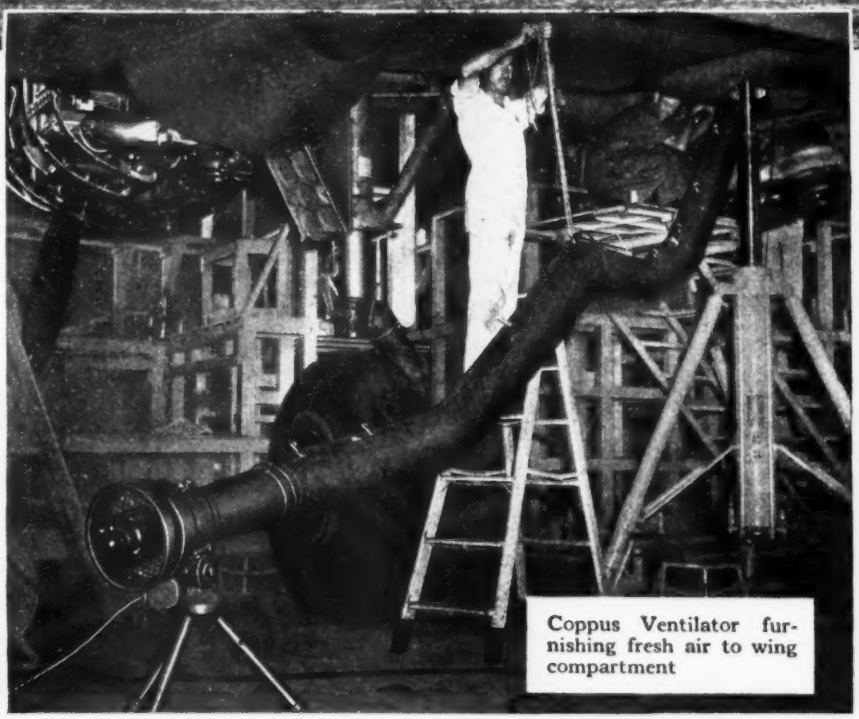
Pan Am Clippers

take the air THROUGH THEIR WINGS!



HOW would *you* like working inside the wing of a plane where air seems to be rationed by the cubic inch? Ever fit an ornery part there while the sweat runs into your eyes and off the end of your nose? If you haven't — try it sometime — you'll understand why 100% efficiency is utterly impossible under such conditions.





Coppus Ventilator furnishing fresh air to wing compartment

This problem has been solved by Pan American World Airways at its new million-dollar Miami hangar, one of the largest in the world. Here Coppus Ventilators supply fresh air to employees working in confined compartments, fuselages and wings. These same Coppus Ventilators are used for field service, too.

Pan American is one of many leading airlines using portable Coppus Blowers and Exhausters to step up production wherever bad air or heat threatens health and efficiency. And Coppus Blowers are used even to inflate barrage balloons for testing seams.

At low cost, you, too, can bring to workers a continued supply of invigorating cool air. The "Blue Ribbon" (a blue band) is your assurance of quality performance at lowest cost. Send for specific information on Coppus Blowers and Exhausters for cable manholes, tanks, shipholds and general man-cooling. Use the coupon.

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A COPPUS
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DESIGNED FOR YOUR INDUSTRY ... ENGINEERED FOR YOU

- ☐ in aeroplane fuselages, wings, etc.
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- ☐ in underground cable manholes.
- ☐ on boiler repair jobs.

Other Applications:

- ☐ general man-cooling.
- ☐ cooling motors, generators, switchboards.
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Write here any special ventilating problem you may have .....

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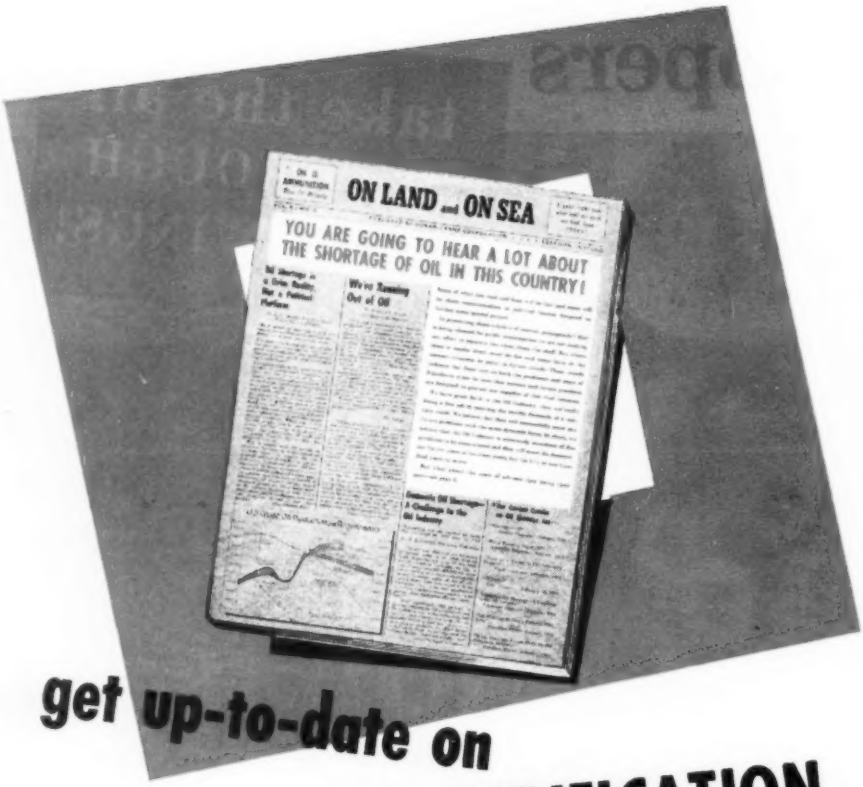

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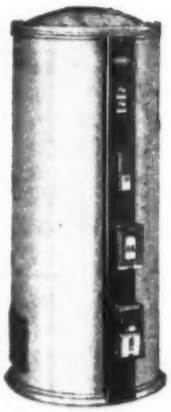

☆ The current issue of the Honan-Crane Publication "On Land and On Sea" contains a brief and very interesting review on "CURRENT OIL SHORTAGES and Their Relation to Industrial Users."

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Gas Turbines

(*Continued from page 93*)

eration in marine service handicaps the gas turbine except as an electric drive.

In the field of electric power generation, the combustion gas cycle will hardly become an important factor unless and until the problems in connection with burning coal as fuel are solved. Westinghouse believes that successful development of the closed cycle is necessary if units of very large capacity are to be built. However, units of a size that can be built for open-cycle operation will include a majority of industrial applications. For emergency standby service and low-first-cost capacity at the end of transmission lines, the open-cycle machine offers many advantages, such as no water requirement, simplicity, small-space occupancy and virtually automatic operation.

In the industrial field, where both power and process steam are required, the gas turbine fits well where the quantity of steam needed is relatively small in relation to the power load. This differs from the extraction steam turbine which fits best where large quantities of process steam per kw of electric load are desirable to attain an efficient cycle. Here again, the use of coal as fuel is essential for a wide general application.

Wait for Proof

In drawing conclusions as to gas-turbine application, it should be remembered that the gas cycle has so far had application only in special cases. The full possibilities of any innovation can be evaluated only from successful proof of economy, first cost, maintenance cost, and reliability. Addition of elements to improve fuel economy and arrangements of the cycle for large capacities are obtained at a sacrifice in simplicity and at a price. Development will be costly in time and money.

Metallurgy plays an important part in gas-turbine development because efficiency increases so rapidly with increase in temperature. To obtain materials suitable for higher temperatures metallurgists are looking at the non-forgeable and non-machinable tool steels. Methods of forming these alloys to shape, such as precision casting to size, may revolutionize accepted methods of manufacture.

To apply such materials, an additional first cost and manufacturing cost must be justified. Application of such materials must be preceded by careful

Again PYRANOL CAPACITORS make the news

Story from *Electrical World*
January 8, 1944, Page 86

Capacitors Improve Welder Performance

By B. L. McARDLE

Electrical Engineer United Steel & Wire Company, Battle Creek, Mich.

When the United Steel & Wire Company turned to war production—landing mats for airplane fields—its requirement of electricity for resistance welding was greatly increased. It was calculated that hourly demand of the plant would be 505 kva., but that instantaneous demand might be much more, resulting from coincidences of welding operations. Tests of the welding machines provided for mat production showed values of the order of 460 kva. and 47 percent power factor for the average 10-cycle welding operation. Under these conditions the voltage drop from the point of regulation at the bus in the utility substation amounted to 25.8 percent. The breakdown of drop showed 11.3 percent in the 7,200 ft. of No. 6, 5-kv. feeder and the 600-kva. transformer bank. The remaining drop of 14.5 percent was in 125 ft. of 500,000-cir. mil, volt welder feeder. It was obvious that the supply line must be improved. This was done by changing the three-feeder to No. 0 conductors, replacing the transformer bank with a three-phase, 10[illegible] unit. It reduced the drop to 10 percent; 11 percent was shown by test later. Further improvement in voltage regulation was accomplished by installation of series capacitors on the welding machines. The capacitors raised the welder voltage, thus permitting a faster input of energy to the weld, reducing its time and speeding up production. They also improved the power factor and cut down the ampere demand. At the low power factor condition of operation without capacitors the instantaneous demand could not exceed 1,750 kva. without causing objectionable lighting flicker on the utility system. Raising the power factor to unity, accomplished by the capacitors, lifted the allowable instantaneous demand to 3,600 kva. and permitted more freedom in welder operation. Further, the improved voltage at the welder did much to avoid erratic operation of the phase-shift electronic control of welder timing.

If series capacitors had not been used tolerable voltage drop could have been obtained only by the use of a much larger quantity of scarce materials in strengthening the energy supply system and welding would have been slower and less well controlled.

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The savings in material, time, labor, and money that can be effected by reducing kva demand through power-factor improvement are more real than with any other method.

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If your plant power system is fully loaded—or overloaded—and has low power factor, ask your G-E representative to estimate how much your circuit capacity can be increased, and the savings that can be realized, by putting in Pyranol* capacitors. Or write for Bulletin GEA-77. *General Electric Company, Schenectady 5, N. Y.*

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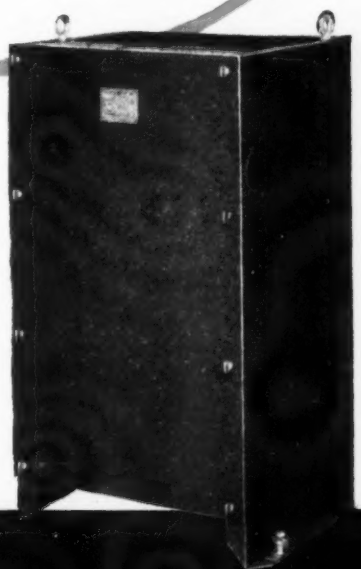

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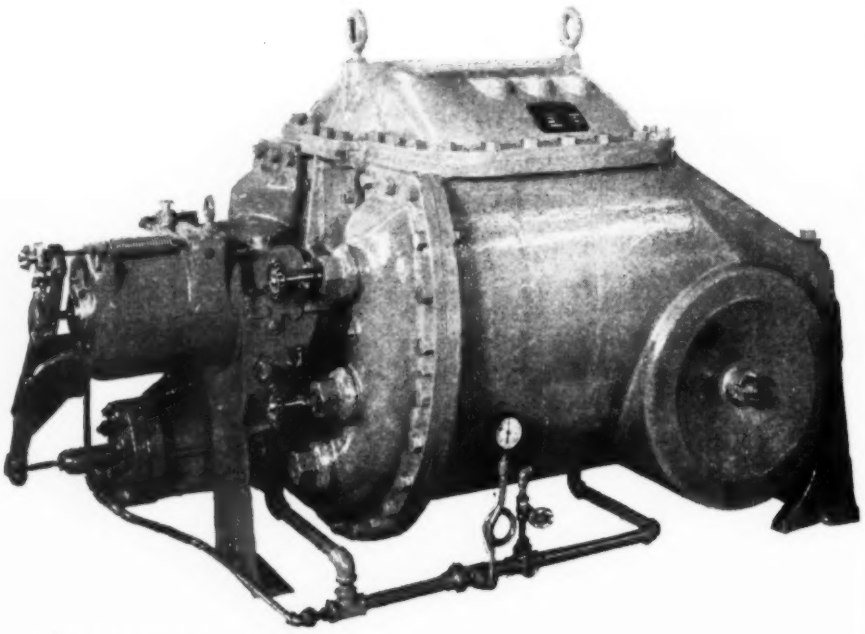
View shows the unit equipped with mechanical shaft type main speed governor and hand speed changer. Also shown is the standard center line exhaust end support and flexible steam end support.

The "UV" turbine can also be provided with oil relay governor either of the constant or variable speed type as well as extraction or extraction mixed pressure gear.



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tests. For heavy-duty apparatus, these tests must extend over long periods before the designer can use them with safety. Careful differentiation between applications as to required length of life of apparatus is essential.

General application of the gas cycle must wait until the postwar era. Development must advance beyond its present early stages before the gas turbine can be judged with assurance. Undoubtedly, the gas cycle will find real usefulness in a number of applications, possibly complementing rather than competing with the steam turbine.

Hardworking Boilers

(*Continued from page* 85)

against operating air pressure under diaphragm (10). Air pressure in this chamber is controlled by multiplying valve (11) which permits air to escape through movement of weighbeams (12) and mercury element. Air pressure feeds under diaphragm (10) through restricted orifice (13). Amplifier rod (7) connects to crank (14) that transmits controlling movement to feedwater-regulating-valve operator.

Mercury-manometer, Fig. 5, consists of two stationary chambers, partly filled with mercury and connected to the boiler drum above and below the water level. The chambers form a U-tube so that variation in head of water in low-pressure column changes the mercury level in the two chambers and moves the float up or down. Levers and linkage transmit float movement to feedwater-regulator-valve controller. One design replaces the float with stepped resistors so that mercury movement increases or decreases current flow in an external controlling circuit.

Varying-pressure-chamber unit, Fig. 6, operates on the theory that when dry steam flows through chamber *F*, having an inlet orifice smaller than the outlet, pressure in *F* is in proportion to that in *J* as the areas of the two orifices are in proportion to each other.

If, however, the steam contains moisture, pressure in *F* increases accordingly because the moisture flashes to steam. Pressure increases in proportion to the moisture content until hot water enters *F*.

When a properly designed open-end pipe extends from chamber *F* down into the water column, dry steam enters the pipe when water level is low and water enters when level is high. Pressure inside the pipe is lower than that in the

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MINIMUM REDUCED PRESSURE	1	0	½	0	0	0	"	"	"	1	1	0	1	0	½	10	½	¼
MAXIMUM REDUCED PRESSURE	125	300	100	200	30	125	"	"	"	15	300	100	500	100	60	200	100	100
FOR DEAD END SERVICE			✔				✔	✔	✔		✔	✔		✔	✔	✔		
DIAPHRAGM ACTUATED—Direct Acting			✔	✔	✔	✔	✔	✔	✔	✔					✔		✔	✔
PISTON ACTUATED—Direct Acting	✔										✔	✔	✔	✔		✔		
AUXILIARY PILOT CONTROL		✔						✔	✔	✔	✔	✔			✔	✔		
SPRING LOADED			✔	✔										✔			✔	✔
WEIGHT LOADED	✔	✔			✔	✔	✔				✔		✔	✔	✔	✔	✔	✔
SERVICE: GENERAL SERVICE	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔					
SERVICE: LOW PRESSURES—Heating	✔		✔	✔	✔	✔	✔	✔		✔	✔	✔	✔			✔	✔	✔
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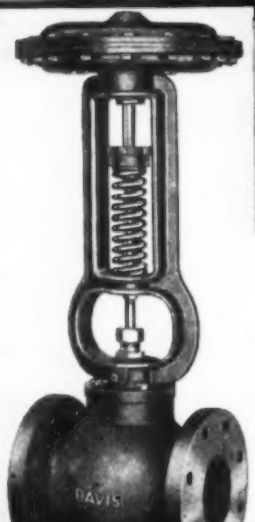
RANGE OF SIZES	¼ to 14	4 to 24	¼ to 2	¼ to 14	¼ to 14	¼ to 14	¼ to 14	¼ to 14	¼ to 2	¼ to 2	¼ to 10	¼ to 14	¼ to 14	2 to 4	½ to 2	2 to 14	¼ to 14	¼ to 14



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water column because of constant discharge through *D*, consequently water level inside the pipe is higher than outside. Holes drilled through the pipe permit steam to mix with the spurting water inside. This gives a gradual increase in the steam's moisture content until the rising-water level covers all the holes.

When the boiler level is low all the holes in sampling pipe *J* are exposed. Then, only dry steam passes to chamber *F* and pressure is not sufficient to close the diaphragm-operated valve connected to line *G*, and feedwater flows to the boiler.

Immersion electrode unit, Fig. 7, consists of several brass electrodes mounted inside of and insulated from an inclosing chamber. The complete unit mounts on the water column or adjacent to the gage glass so that the water level makes or breaks an electrical circuit through the electrodes. One side of the control circuit passes through the water to ground and back to the power supply. A circuit to the solenoid valve, electric valve or pump motor is broken or completed as the water falls or rises inside the electrode holder.

Aneroid-manometer, Fig. 8, is a differential-pressure-measuring device that connects to the boiler drum above and below the water level. High-pressure line connects outside of the bellows, and low-pressure connection goes to the inside. No filling liquid is used other than that being measured. As the differential pressure increases, free end of bellows moves to the left. A yoke on the bellows leads to a lever that connects to a shaft welded to the inboard end of a torque tube. The bellows' movement is, therefore, transferred through the yoke strip and lever, which imparts a rotary movement to this end of the tube and shaft.

Simple Elements

In the simple or 1-element control (units previously described) the regulator is affected only by the level of water in the boiler drum. These actuating principles provide feedwater regulators that feed continuously. Under a steady load they proportion the feed exactly to the steam output and hold the drum water level constant so long as this particular load obtains. The original and simplest actuator is a float operating in a chamber connected with the boiler drum. As the float descends with a lowering water level it opens the feed valve by suitable mechanical linkage.

Since 1-element regulators change the feed valve position only with change in drum level, valve opening increases only

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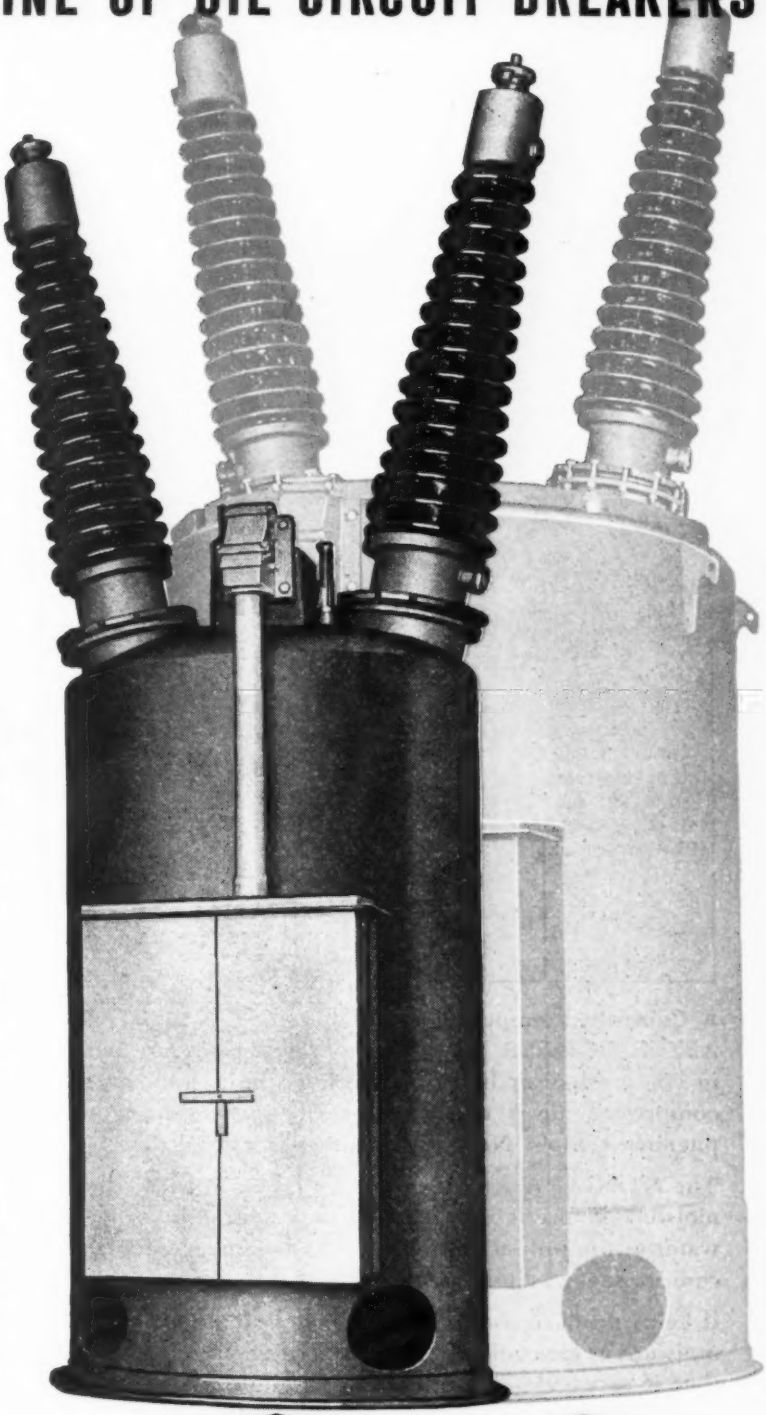

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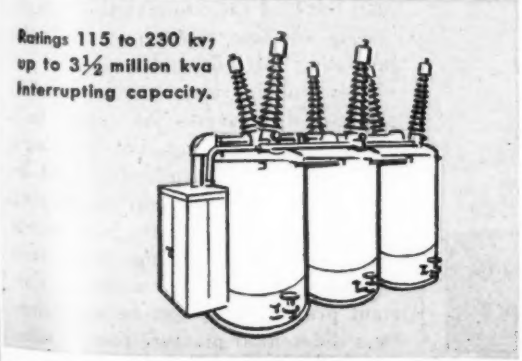

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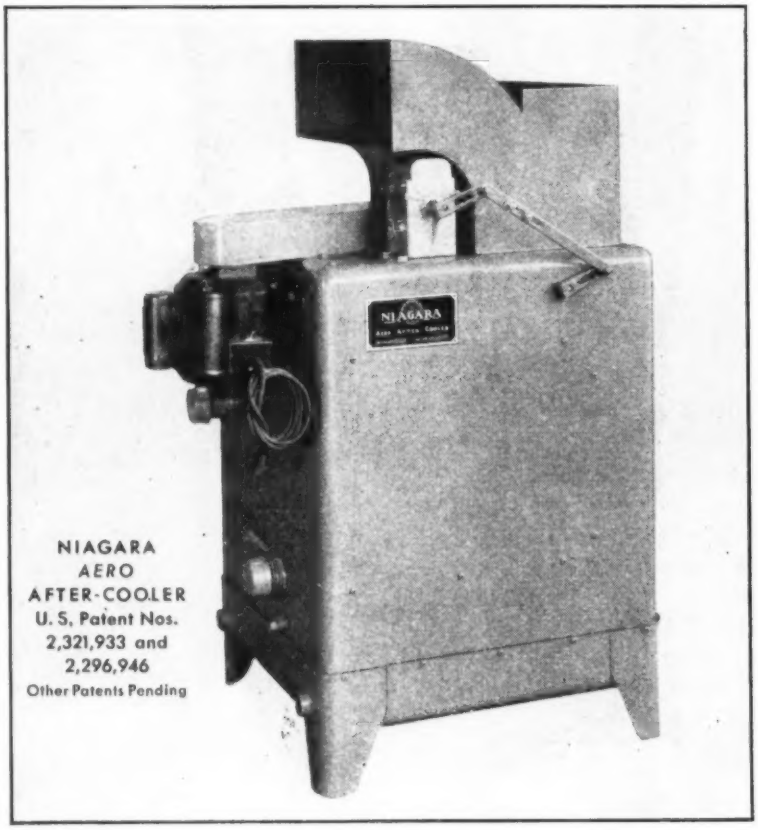

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when the drum level falls which produces a falling characteristic, carrying a lower level with each load increase.

This inherent characteristic, acting under swell and shrinkage of water volume, materially assists in maintaining constant boiler pressure during sudden load changes by utilizing the heat-reservoir effect of the boiler. One-element regulation is entirely satisfactory for many applications because it offers low first cost and greatest simplicity. But for applications requiring other than a falling characteristic, regulation must be under the control of more than one element, as in the following 2- and 3-element systems.

Steam-flow, or 2-element, regulator, Fig. 9. Primary control, which is by rate of steam flow from the boiler, anticipates the rate of change and stabilizes the level instantly. A 1-element control is added to determine at what drum level stabilization occurs. Since the steam-flow element can be adjusted for any predominance it is capable of giving the rising characteristic required for most efficient operation.

Feedwater valve is controlled jointly by both elements. The steam-flow unit may be actuated by pressure drop through the superheater or an orifice placed in the main steam outlet. Increased flow through the orifice or superheater results in a greater pressure drop through it, which causes the feed valve to open a definite amount.

3-Element Regulators

Balanced-flow, or 3-element, regulator, Fig. 10, is a steam-flow and 1-element regulator to which has been added a third element—one responsive to the rate of feedwater flow. Water-flow element is similar to the steam-flow element, but is actuated by pressure drop through the feedwater heater or through an orifice placed in the feed pipe. Predominant control is from steam flow. In the 2-element control, operating conditions call for a certain opening of the feed valve. In the 3-element regulator, the first two elements call for a certain rate of feed, and the third element adjusts the feed valve to give this rate.

Rate of flow through a feedwater regulating valve depends primarily on: (1) area of the valve opening, and (2) pressure drop across the valve. In a 1- or 2-element control (not involving a water-flow element) a certain feed demands a certain valve position. If pressure drop across the valve is subject to wide variations, feeding rate varies widely for a given valve opening. Constant pressure drop can be maintained by a differential pressure control valve.

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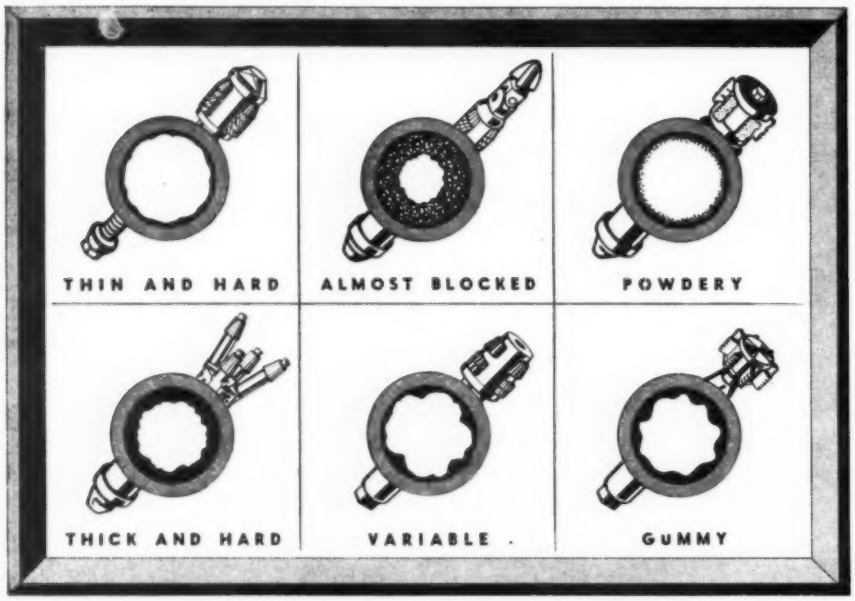

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Fig. 11, installed ahead of each feedwater regulating valve. This is simply a diaphragm or bellows-operated valve actuated by the differential pressure across the main feed valve.

Correct feedwater regulation equalizes the load among all boilers and eliminates any tendency toward load swapping. Steam pressure is more uniform and efficiency is higher.

Producer Gas

(*Continued from page* 87)

penalize any gas, as compared with oil fuel, and lean gases far more than rich gases. Yet further study shows that compression of the fuel gas, lean or otherwise, involves no net loss in theory and, with proper equipment, very little under commercial conditions.

The determining factor in any case is the permissible temperature of the combustion products at the gas-turbine inlet. This temperature is limited by the turbine metals rather than by the nature of the fuel gas. If it is to be 1200 F, the fuel heat supplied (allowing 400 F at end of compression) must be about 15 Btu per cu ft of combustion products delivered to the turbine. Thus the products of "*perfect combustion* in any case must be enormously diluted (about 600%) with whatever is handy, mainly excess air.

If the fuel gas used is loaded with inert nitrogen this is just as serviceable as excess air for diluting purposes. Thus the fuel-gas compressed merely replaces an equal volume of compressed air. For example, in the preceding table, shifting from oil fuel to blast-furnace gas adds a gas compressing load of 126 cu ft per kwhr, but unburdens the air compressor of an equal volume.

Excess and deficit cancel unless the gas compressor is less efficient than the larger air compressor. In one foreign installation (March POWER, pg 69), a gas turbine fired by blast-furnace gas drives an axial compressor for furnace blast and turbine air. The turbine and main compressor run at 4500 rpm. and the fuel-gas compressor is a much smaller, but equally efficient, machine geared to 9000 rpm. Thus, in fact as well as in theory, the use of a lean fuel gas need have no important detrimental effect on gas-turbine-plant over-all efficiency.

So it seems that the gas producer and the gas turbine may become effective partners, each expanding the economic field of the other. Yet one

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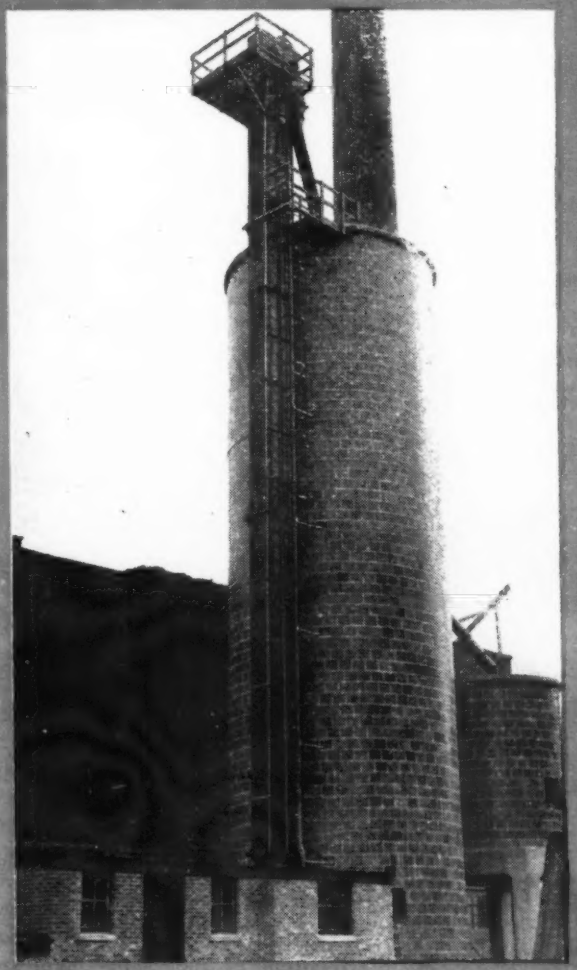

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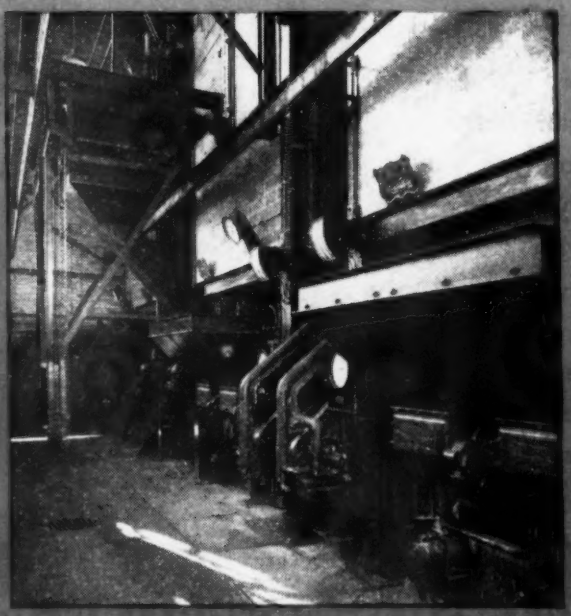
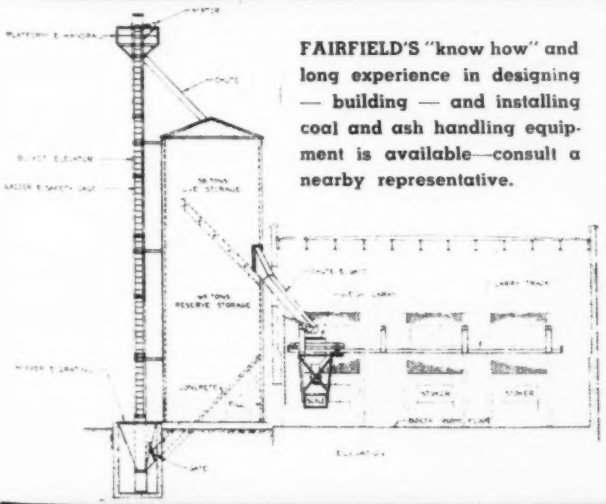
The coal is stored under roof—the silo is moisture free being made of vitrified hollow tile—it requires very little space being of circular construction—location outside of plant eliminates dust and dirt inside.

There are many different arrangements each is engineered to fit individual conditions and the entire system is developed — built — and erected by Fairfield.

The installation shown comprises both coal and ash silos and is one of many successful units now in operation.

The interior installation shows a weigh larry used to feed the coal to the stokers and handles coal directly from the silo.





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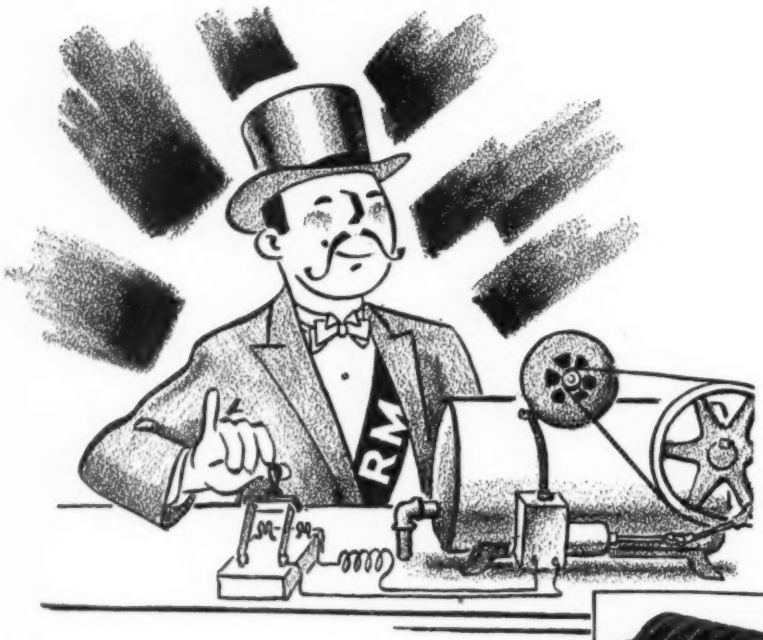

The life-blood of many finished materials of war is the basic fluids that are a vital part of the manufacturing process. Oils, acids, alkalis, solvents, etc., require very special packings in pumps and lines to withstand chemical attack and keep fluids flowing.

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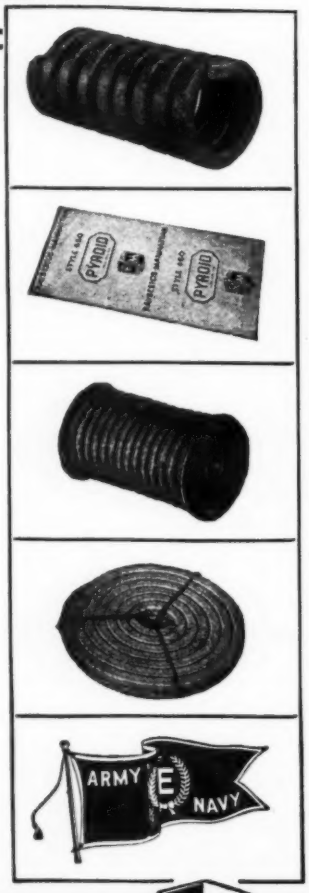

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should not conclude that the gas-producer gas-turbine power team can easily overcome the initial economic advantage of steam in coal-consuming districts.

Compare with Steam Plant

Assume, for example, that a complete gas-producer gas-turbine plant costs the same as a complete steam plant, uses the same fuel and labor and has the same reliability and life. Assume that the producer shows an efficiency of 80%. Then the efficiency of the gas-turbine plant, *from cold gas on*, would have to be one quarter higher than that of the complete steam plant for an even economic break.

It is not the purpose of this article to present technical or practical data for potential designers or operators of gas producers. This can be found in gas-producer literature, most of which was published some years back.

These general comments will have served their purpose if they direct the attention of fuel technologists, gas-turbine designers and power engineers to the important advances that may hinge on the pairing of the gas turbine with producer gas or water gas.

Other Possibilities

In closing, certain other coal-burning possibilities should be mentioned briefly for the record. One is the *slagging* gas producer, somewhat resembling a small blast furnace. Slagging operation (a well-tested technique) permits high gasification rates with low-fusion coal, and may point the way to lower fuel and labor cost, and fixed charges for large-scale gas production.

Another is the supercharged producer blown with a small fraction of the output of the main compressor. The resulting hot, compressed fuel gas would presumably be burned in the raw state. Such a producer would operate (slagging probably) at a very high rate and with a hot-gas efficiency above 90%. Problems to be solved would include coal charging, ash removal and removal of dust from gas.

Still another proposal is the direct application of coal-fired-furnace heat to tubes carrying compressed air or other working fluid in a closed cycle.

Finally, well-known fuel technologists have stated that a rich gas under substantial pressure can be transported by pipeline cheaper than the same heat quantity can be hauled in the form of coal. Generated cheaply at the mine (but not by the producer-gas process) such gas may some day be piped hundreds of miles to supply low-cost heat to gas turbines generating electricity or mechanical power.

IN PLANNING YOUR FUTURE PROJECTS CONSIDER

SHAW PIPING

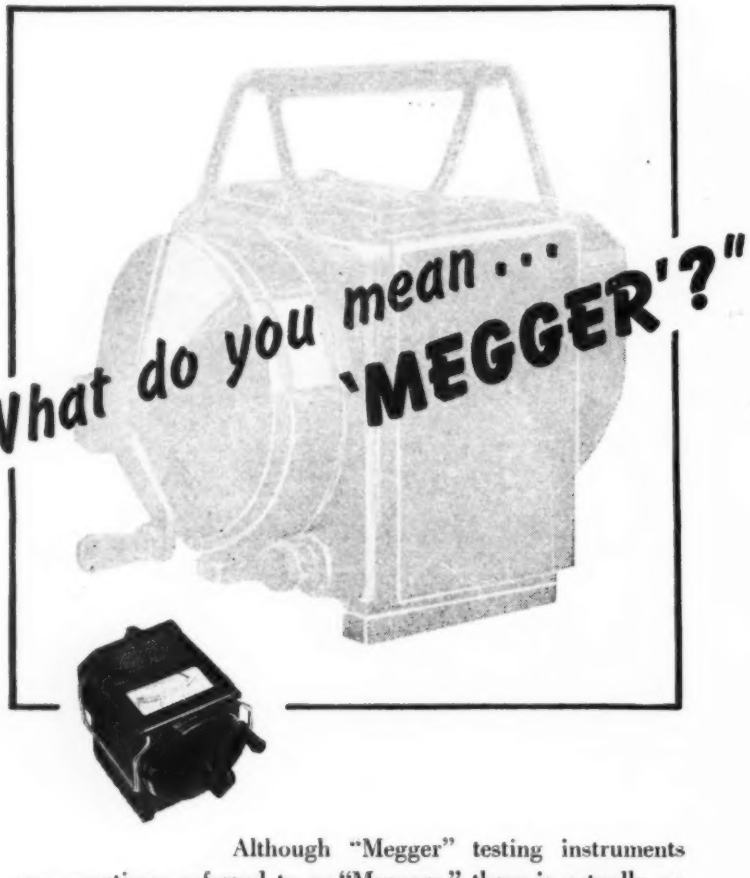
Pre-Fabrication & Installation

51 years of experience in the Piping Field has made the Shaw name synonymous with Dependability.

J. Frederick Meng Sales Manager

BENJAMIN F. SHAW COMPANY

2nd and Lombard Streets, Wilmington, Delaware



Although "Megger" testing instruments are sometimes referred to as "Meggers," there is actually no such thing as "a Megger." Why? Because the name "Megger" is a trade mark which is registered in the U. S. Patent Office and it applies in this country *only* to certain electrical instruments that are sold exclusively by the James G. Biddle Company. • These facts are re-stated here to prevent misunderstandings that may arise from careless or misleading use of the term "Megger." • The more widely used of these "Megger" instruments are listed below. Full information will be furnished on inquiry.

"Megger" Insulation Testers.....*Bulletin 1735-P*
"Bridge-Meg" Resistance Testers.....*Catalog 1685-P*
Midget "Megger" Testers .....*Bulletin 1690-P*
Midget "Megger" Circuit Testing Ohmmeters .....*Bulletin 1495-P*
"Megger" Ground Testers.....*Catalog 1645-P*
"Ducter" Low Range Ohmmeters.....*Bulletin 1635-P*

"MEGGER"
TRADE MARK REGISTERED U.S.PAT. OFF.

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

New Equipment

(*Continued from page* 126)

all features of Murphy automatic separator. All separated moisture descends to trap under bottom head and is automatically ejected as fast as collected. Made in 1-, 1½-, 2- and 3-in. sizes with legs, as shown, or suspension lugs welded on head. *Jas A Murphy & Co, Hamilton, Ohio.*

Storage-Battery Welders

A PRACTICAL DIRECT-CURRENT resistance welder uses storage batteries as a source of welding current. It makes possible the application of resistance welding, even in aluminum, in localities where power supply is limited. The only requirement is sufficient power to operate a battery charger. *Progressive Welder Co, 3050 E Outer Dr, Detroit 12. Mich.*

Testing Set

PORTABLLE HIGH-VOLTAGE TESTING SET, with a rating of 300 kva at 30,000 or 60,000 v, is for high-potential tests on generators, motors, cable, bus structures and short sections of transmission lines. Equipment includes a single-phase oil-immersed 60-cycle transformer. Low-voltage winding of transformer is rated 4600 v and is supplied through a single-phase oil-immersed induction voltage regulator, rated 75 kva, 60 cycles, 2300 v, 100% raise and lower regulation. With a 2300-v power input, regulator can vary primary voltage of testing transformer from 0 to 4600 v, so that all tests may be started at zero voltage and then raised to any value up to 30,000 or 60,000 v. Transformer is designed for 50% magnetizing current, to help balance off part of load-charging current, thereby permitting considerable reduction in size and weight of equipment for a given load. Control panel is mounted at front and contains an oil circuit breaker, ammeter, voltmeter,

Yes, Men Make Motors!

NO MACHINE KNOWN can duplicate the skill of Sam Meister, left, of Allis-Chalmers Norwood Works.

Holding an acetylene torch in his right hand, a silver alloy rod in his left, Sam silver-brazes end connections of Allis-Chalmers' "Indestructible Rotor."

Round and round the connections he works — expertly flowing in molten alloy to form a joined structure that can withstand as much heat as though it were a single die-casting.

No machine can do that job — and no machine can fully test how well it is done.

There's only one test . . . wait 5, 10, 15 years and *see.*

And that's the test in which Allis-Chalmers motors have proved over the years that they're *great* motors. That's why you hear it said so often: *"You can depend on Allis-Chalmers Motors!"*

• • •

YES, HUNDREDS of Allis-Chalmers men—craftsmen like Sam Meister — know they have a big personal stake in every Allis-Chalmers motor. When they build a great motor for you, they're making a *friend* . . . and they know that's something no company and its workers can have too many of.

Next time *you* need great motors contact our district office. Or write direct to ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

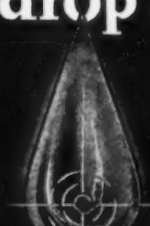
A 1730

WE WORK FOR VICTORY WE PLAN FOR PEACE

♪ *Tune in the Boston Symphony, Blue Network, Saturday at 8:30 pm, EWT.*

YOU CAN DEPEND ON ALLIS-CHALMERS MOTORS

Just a drop of water-

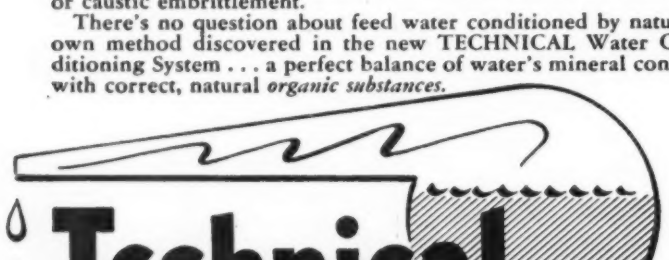


harmless...

or is it?

Although specially treated for use in your water consuming equipment, it may still contain a sufficient amount of water hardness to cause boiler scale, priming, foaming, pitting or corrosion or caustic embrittlement.

There's no question about feed water conditioned by nature's own method discovered in the new TECHNICAL Water Conditioning System . . . a perfect balance of water's mineral content with correct, natural *organic substances.*



WATER CONDITIONING SYSTEM

TECHNICAL is a proven, natural system of individual formulas to fit each and every water type. It provides a special balance of water properties that definitely overcome scale, foaming, pitting, corrosion, priming, caustic embrittlement characteristic of boilers and condenser covering systems.

For your own satisfaction, investigate the new TECHNICAL System . . . Nature's own conditioning method developed under actual industrial operating conditions. Without obligation the coupon below will bring you the facts.

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☐ Please send the new Technical System bulletin.
☐ Have a Water Treatment Company engineer call.

Name_____ Title_____

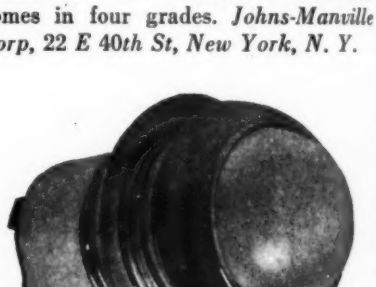
Company_____

Address_____

over-current relay, signal lights and regulator motor switch. Output voltmeter reads directly in kilovolts and is energized from a voltmeter coil built into transformer high-voltage winding. To prevent application of overvoltage to apparatus under test, an adjustable sphere gap is mounted on transformer cover. Series or parallel connections of high-voltage winding are made by links mounted on tops of high-voltage terminals. *General Electric Co, Schenectady, N. Y.*

Refractory Lining

INSULATING FIREBLOK, similar in composition and properties to J-M insulating firebrick, is suitable for same range of temperature conditions. Difference is that one Fireblok will cover more surface than five full-sized firebricks. Fireblok is 9x24 in., 9x12 in., 4½x24 in. and 4½x12 in. Standard thicknesses are 2½, 3 and 4½ in. Special sizes and thicknesses are available. Fireblok comes in four grades. *Johns-Manville Corp, 22 E 40th St, New York, N. Y.*



Indicating Light

S11 UNIT, for Standard S11 10-w lamp bulb, is available in all colors. Bulb is so recessed into unit from panel front that exposed tip assumes appearance of a lens. It is said that this unit provides such exterior ventilation to lamp bulb that lamp life is greater. S11 unit is also claimed to protect bulb against breakage. Pilot light is for panel or switchplate mounting. *H R Kirkland Co, Morristown, N. J.*

Unbreakable Manometers

SHATTERPROOF TENITE replaces glass tubing to make portable and stationary manometers, for checking pressures in boilers and air-conditioning units, rugged, yet accurate and easy to read. Tenite seamless tubing bends easily into desired position. Tube ends are threaded for screw caps. L-connectors, of slightly smaller tubing, vent gages to atmosphere and open them for addition of water, oil or mercury. Connectors are tapered and pressed in to make leak-

LOST!

Somewhere along the line the company is losing thousands of dollars through leaky valves. Finder please notify Management.
REWARD

Let's do something about it THE DEXTER WAY!

Let's stop the valve leaks! They can really run into three-figure totals every month — besides costing man-hours and machine production and output spoilage . . .

Let's stop the valve leaks *without removing the valve from the line!* One or two men, with Dexter Valve Reseating Equipment can easily repair and *keep in repair* every globe, gate and pump valve, wherever a man can get at it. No costly breaking-out, no new parts needed, no delays for "factory repair jobs." And we furnish instructions so simple and complete that a man of ordinary intelligence can do the job correctly — *and quickly*.

Tell us about your most troublesome valve

Give us the make, type, size and material — the fluid handled and its pressure — and we'll quote you on the Dexter Valve Reseating Outfit needed to take care of it. One repair job has been known to pay for the Dexter Equipment — so write us today — don't delay.

FOUND!

..by the Chief Engineer, who answered an ad in a trade journal and bought...

FOR GLOBE, GATE AND PUMP VALVES

DEXTER VALVE RESEATING EQUIPMENT

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

YOUR ANSWER for speeding wartime MAINTENANCE

How to Clean Steam Condensate Meters

Your steam condensate meters must indicate and record steam flow accurately. To maintain the volumetric capacity of these units periodic cleaning, overhauling and restandardizing is essential. That is why it will pay you to use a NEW specialized Oakite technique that speedily rids meters of ALL foreign matter.

Just immerse meter drums in recommended solution of Oakite Composition No. 24 for removal of oil, grease and dirt. Rinse and then place in Oakite Compound No. 32 solution to remove lime scale and rust. Method saves time, does thorough job, restores efficiency of unit.

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Time-saving data on how you can expedite this and 64 other power plant maintenance jobs is given in a new FREE 16-page Digest.

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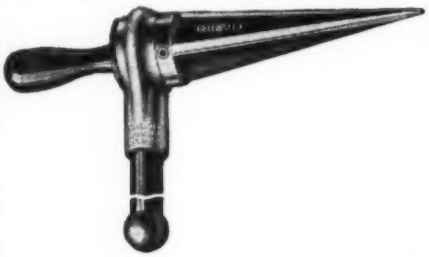
OAKITE *Specialized* CLEANING

Buy Bonds for Victory

proof connections. Manometers are manufactured by *F W Dwyer Mfg Co*, with tubing extruded by *Sandee Mfg Co*, both of *Chicago*. The Tenite is a cellulose acetate-butyrate product of *Tennessee Eastman Corp, Kingsport, Tenn.*

Fireclay Bricks

HYEX, SUPER-HYEX AND SUPERAM are additions to refractory line. Hyex is for all general applications where resistance to spalling is the principal consideration. Super-Hyex is superior to Hyex in its freedom from shrinkage and deformation, its higher resistance to certain slags and fluxes, and its load-bearing characteristics at high temperatures. Superam supplies demand for large and intricate shapes that meet blueprint dimensions and that cannot be made by Hyex and Super-Hyex processes. It has same characteristics as the other two brands. *McLeod & Henry Co, Troy, N. Y.*



Pipe Reamer

RIDGID PIPE REAMER of extra long taper design has been added to company line. As a result of the long taper, reamer is claimed not only to avoid flaring, splitting or reducing pipe wall but to cut burr cleanly and easily from inside of pipe or conduit. It is furnished with ratchet handle, or can be used with ratchet handle of Ridgid No. 00R ratchet threader. *Ridge Tool Co, Elyria, Ohio.*

Air Filter

DESIGNED ESPECIALLY for quick installation on all standard dc generator units, impingement filter unit traps all dust particles before they reach rotating equipment parts. On any similar motor or generator, it doubles brush life and prevents *frozen* or clogged rotors, according to manufacturer. Filter medium is permanent. Incased in arc-welded steel frame, it is removed easily for quick cleaning. Filter sizes fit all standard welders, having standard or special sizes for any machine or equipment. *Air Devices, Inc, 17 E 42nd St, New York 17, N. Y.*

No Other Refractory Coating Is Like BRICKSEAL

★ **Forms a highly-glazed, protective, monolithic surface**

Brickseal is the only refractory coating we know of which consists of high-fusion clays and metals combined with oils. Unlike air-set washes which form only a plaster-like coating on the refractory surface, Brickseal actually becomes an integral part of the brickwork. The heat of the fire-box drives out the oils and vitrifies the clays and metals, penetrating deeply into brick pores, cracks and joints, and forming a highly-glazed, air-tight, monolithic wall.

Brickseal cannot crack, blister or peel off due to sudden temperature changes because it remains semi-plastic until the furnace cools, when Brickseal becomes hard as steel. Boiler can be used immediately after Brickseal application. The glossy Brickseal surface reflects heat, prevents air infiltration, and permits increased production with less fuel. Maintenance expense due to cracking, spalling or erosion is reduced or eliminated entirely with Brickseal.

Brickseal is applied easily with brush or spray gun. Its cost is insignificant compared with the results it produces.

Write for sample or Brickseal representative.

BRICKSEAL
REFRACTORY CO.
1029 CLINTON ST., HOBOKEN, N. J.

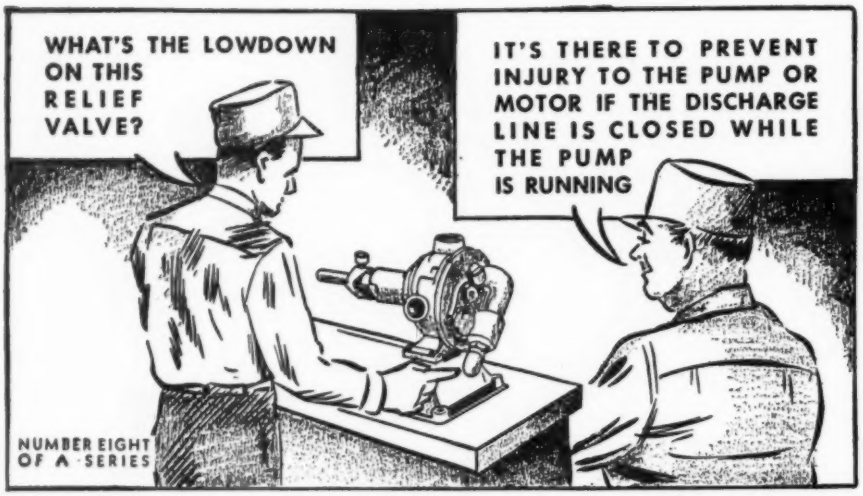
KENNEDY
BRONZE GLOBE VALVES

All Standard Disc Types

Fig. 89
Bronze Globe Valve
with Renewable
Composition Disc

You will find that these valves operate easily . . . close tightly . . . give dependable, lasting service. Fig. 89 illustrated is typical of Kennedy Bronze Globe Valves . . . strong . . . designed to speed-up piping jobs . . . simplify operation . . . keep maintenance costs low. Available disc types include bronze, renewable composition, regrinding, full way, and plug type for steam pressures up to 300 lbs. For complete catalog, write

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.


WHAT'S THE LOWDOWN ON THIS RELIEF VALVE?
IT'S THERE TO PREVENT INJURY TO THE PUMP OR MOTOR IF THE DISCHARGE LINE IS CLOSED WHILE THE PUMP IS RUNNING
NUMBER EIGHT OF A SERIES

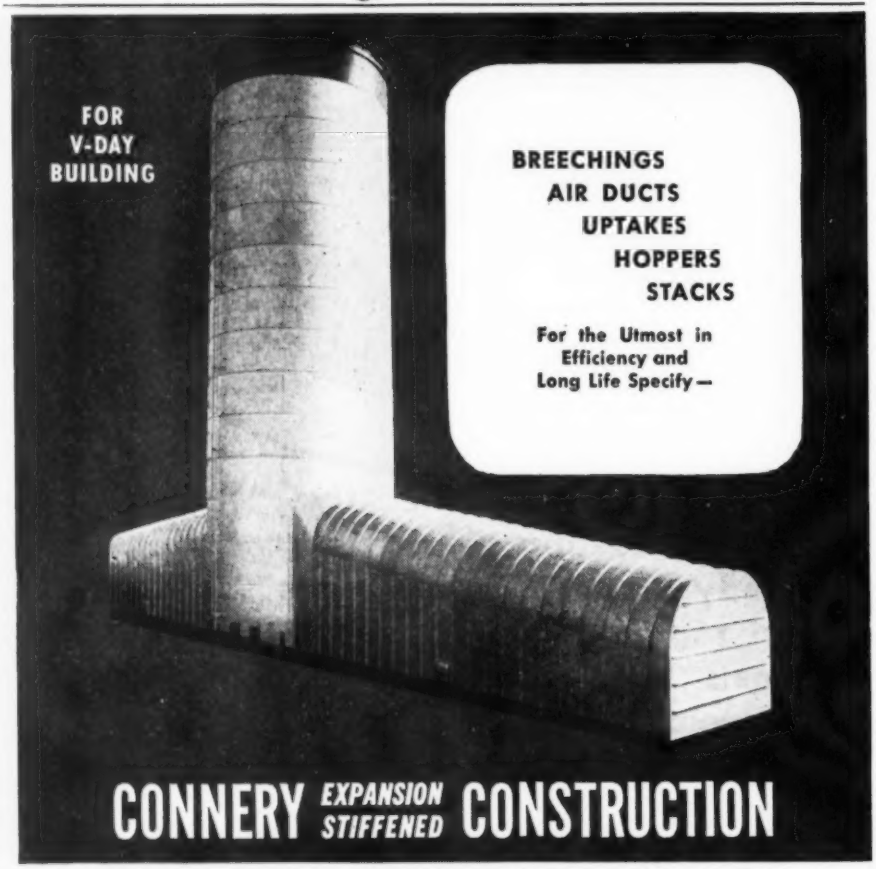
How To Get The Most Work Out Of Your VIKING PUMPS

Viking Rotary Pumps are positive in action, delivering an equal amount per revolution of the pump shaft. If there is any chance that the discharge line may be shut off when the pump is running, install a Viking relief valve to prevent injury to the pump or motor. Pressure of this valve can be regulated through the adjusting screw which tightens or loosens the valve spring. When installing such a valve, the larger end, where the adjusting screw is located, must always be placed toward the suction side of the pump.

Make your pumps last longer by giving them better care. The Viking Service Manual offers you clear, practical help in mounting, operating and maintaining Viking Rotary Pumps. Write for your copy today. It's FREE.

VIKING PUMPS — FIRST IN AMERICA

VIKING Pump COMPANY
CEDAR FALLS, IOWA



CONNERY CONSTRUCTION CO.
SECOND & LUZERNE STS. PHILADELPHIA

Readers' Problems

(*Continued from page* 112)

from 80 psi into the heating-system return. Cutting off the trap as a test stopped the hammer, but inspection showed excellent condition and operation. However, another trap was placed on the kettles. The hammer resumed. This led me to suspect the return, which I found to be large enough for the kettles or radiators, but not for both. The kettles had been installed at a later date and, to save pipe, condensate was fed to the heating-system return.

Upon checking the system systematically I found a more pertinent cause in a leaky radiator steam valve. Opening this valve stopped the hammer as effectively as cutting off the trap had done. Although not needed for heating, this radiator was left on until warmer weather permitted opening the system for inspection.

Marissa, Ill. GEORGE HOLMAN

Look for Low Spots

IN EITHER 1- or 2-pipe gravity-return system, pipes and radiators must be sloped so that condensate drains away without interfering with steam flow. If steam is suddenly turned into a cold system, serious hammer occurs.

In a 2-pipe system, radiators and radiator runs should slope toward the drain pipe so that steam and condensate move in the same direction. Mains should slope away from the boiler or reducing valve and have drains (preferably with traps) at their ends.

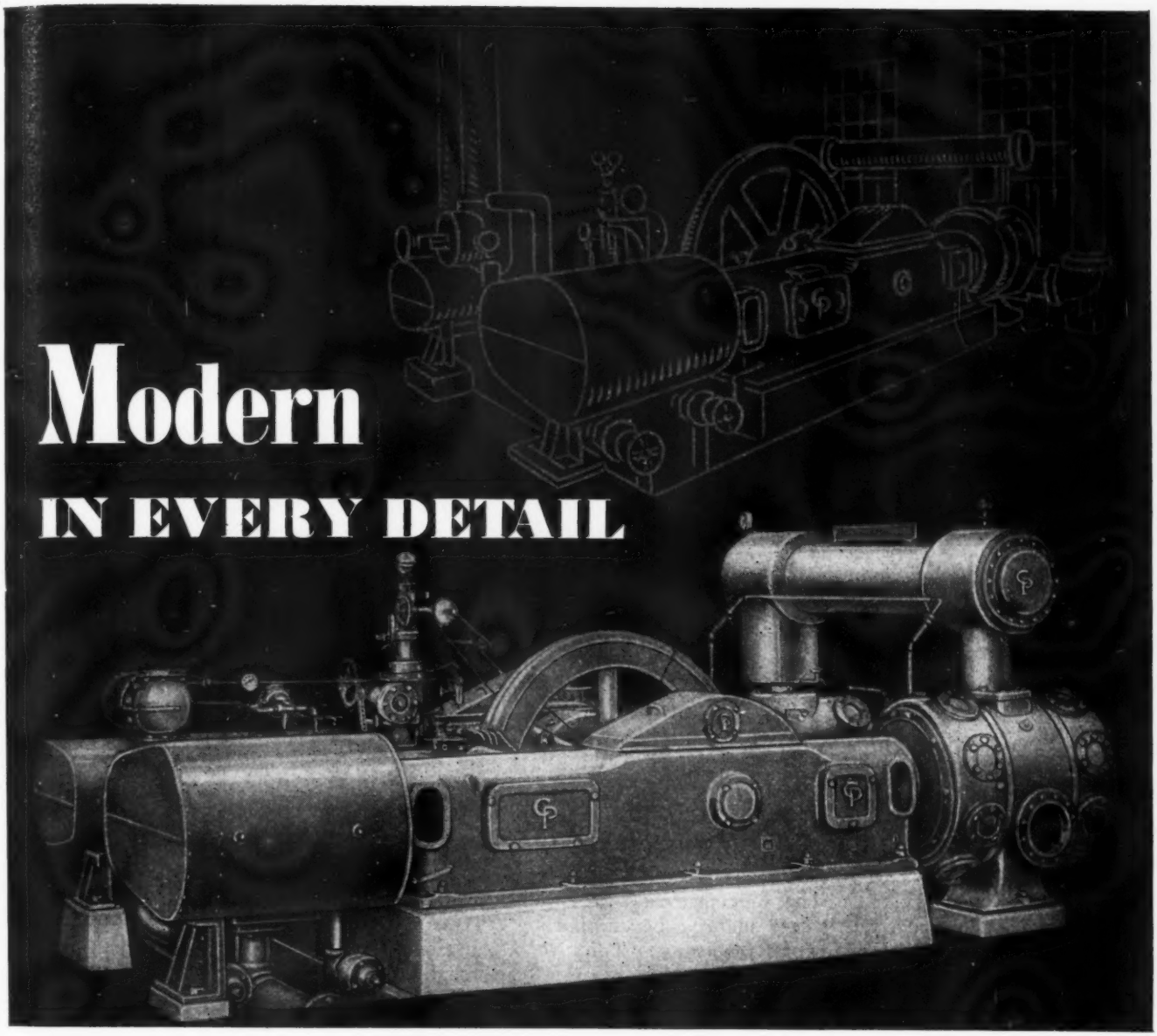
Radiators should be equipped with air vents and thermostatic traps. If the latter are not used pressure in the return line may hold condensate in the radiators and cause hammer or, if the supply valve is shut off and the return valve left open water runs out vent.

In a single-pipe system mains should slope back toward the source to the return pump or be drained through traps to the pump. Horizontal pipes and radiators should slope ½ in. every 10 ft.

If WH's system has low spots that cannot be eliminated by changing the piping or raising the radiators, drain them through traps to the condensate tank. He may be carrying too much pressure on his heating system so that condensate cannot drain back as it should or some of the pipes may be so small that condensate is carried along with steam instead of draining back.

Lombard, Ill. H D BROWN

(*Continued on page* 176)



CLASS H STEAM DRIVEN COMPRESSOR

FORTY years of experience went into the building of CP Class H – latest model of CP Steam Driven compressors.

A thoroughly modern steam end, proportioned to the purchaser's steam conditions, combined with full force-feed lubrication of the running gear and a highly efficient air end with its Simplate Valves, all contribute to the high overall economy of these CP machines. The double crosshead-tie rod construction provides direct, straight-line transmission of power from steam end to air end. Capacities range from 400 to 6600 c.f.m., 100 to 125 pounds air pressure. Other sizes in single and multi-stage design for lower and higher pressures. Write for literature.

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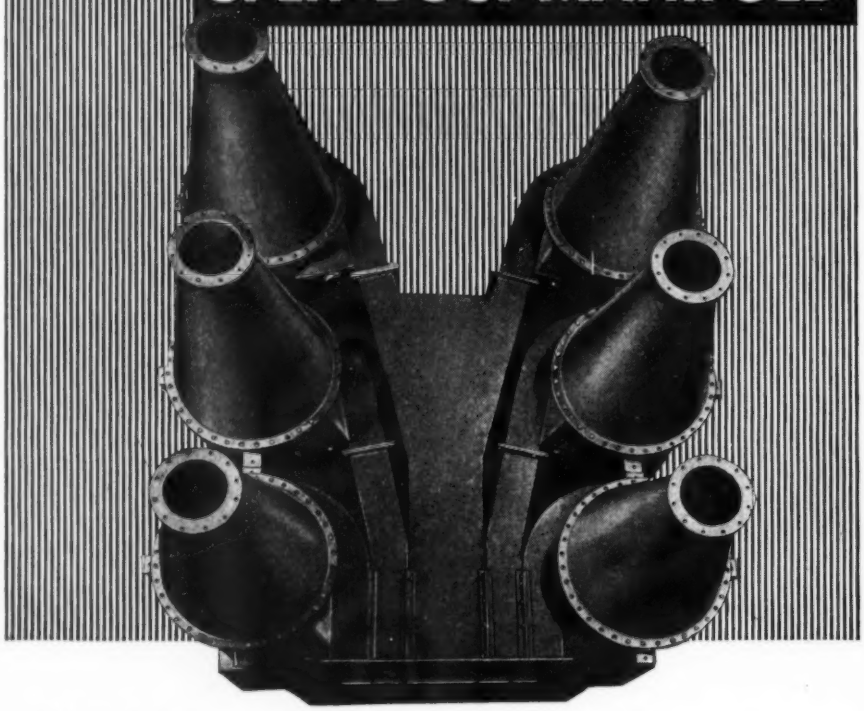
ELECTRIC TOOLS
(Hicycle...Universal)
ROCK DRILLS

CHICAGO PNEUMATIC
TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES

Next to Correct Hopper Design . . .

SPLIT-DUCT MANIFOLD



No. 5 Reason for

Buell's High Efficiency, Low Maintenance, Long Life

• THE SPLIT-DUCT manifold as used on Buell multiple-cyclone collectors is designed to assure *uniform* distribution of both gas and dust to the cyclones. This design is most important to the final efficiency of the collector; for uneven dust distribution can cause local recirculation of gas with the consequent impairment of efficiency. Uneven distribution of dust results in greater erosion rates in the cyclone collectors receiving the higher concentrations. ☆ With Buell's split-duct manifolding, the maximum efficiency is attained by reason of this even gas distribution. The outlet can be installed to discharge the cleaned gases from any side or end—a flexibility of arrangement that is impossible with unit-chamber manifolding. ☆ These advantages are indicative of the careful design and workmanship throughout every Buell Dust Collector, and their superior performance is attested by more than 500 installations in United States industries alone. ☆ Every Buell installation is designed especially for its own individual job and purpose.

Engineers will find substantiation of these claims in Buell's factual, 28-page book—"The van Tongeren System of Industrial Dust Recovery." Ask for Bulletin G-842.

BUELL ENGINEERING COMPANY, INC.
10 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

buell
DUST RECOVERY SYSTEMS

BUELL FEATURES	RESULT IN	PRODUCE
SHAVE-OFF LARGE DIAMETERS	HIGH COLLECTION EFFICIENCY	GREATER RECOVERY
EXTRA-THICK METAL	LESS FAN BLADE WEAR	LOW MAINTENANCE
LARGE OUTLETS	LOW DRAFT LOSS	LOW OPERATING COST
INNER WELDS GROUND SMOOTH	LOW POWER CONSUMPTION	LONG LIFE
CORRECTLY DESIGNED HOPPERS	HIGH TEMPERATURE RESISTANCE	NO CLOGGING
SPLIT-DUCT MANIFOLDS	UNLIMITED CAPACITY	
	NO MOVING PARTS	
	FREE DUST FLOW	

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

Suggests Vacuum Pump

SOME OF WH's RADIATOR TRAPS may not be operating properly, and may be blowing steam into the returns. Parts of the return piping may not be pitched properly, allowing slugs of water to accumulate in low spots. Long return lines with excessive fitting and pipe friction foster sluggish flow; this causes condensate to accumulate in the returns, with the steam trying to push the water to its destination.

Check the conditions mentioned thoroughly, looking for broken or sagging hangers on the return piping and making sure that radiator traps work properly. In addition, a vacuum pump installed in the main return of each building or each group of buildings maintains a 6 to 12-in. vacuum and keeps returns free of condensate.

It may also be practicable to reduce pressure from 5 to 2 psi or even lower. Installation of a vacuum pump or pumps is of primary importance in heating systems of this type and rates first consideration.

We use low-pressure steam for heating, carrying ½ to 1 psi in cold weather and cutting it back to atmospheric pressure during mild periods. Holding 6-in. vacuum on one system and 10 to 12-in. on the larger system we have no difficulty in maintaining satisfactory temperatures with no water hammer.

Ansonia, Conn. W T ESTLICK

Answers to Mar. Question 2

(*Continued from page* 113)

phase circuit. As a synchronous generator is loaded its rotor advances, as compared with the similar angular position of the polyphase circuit. This shift may be a few degrees or only a fraction of a degree.

For example, the load on a synchronous frequency changer connecting two different systems can be changed by changing the angular position of the generator with respect to the motor. This is done by moving the stator of one machine in its cradle, a few degrees in respect to its own rotor.

Rotors and stators of PT's two machines are so mounted together mechanically that when the large generator carries 5000 kw, the small generator is in exactly the same angular position as the polyphase system to which the generators are connected. If the small machine's stator were mounted in a cradle so he could rotate it a few degrees, he could parallel the small generator when the large generator

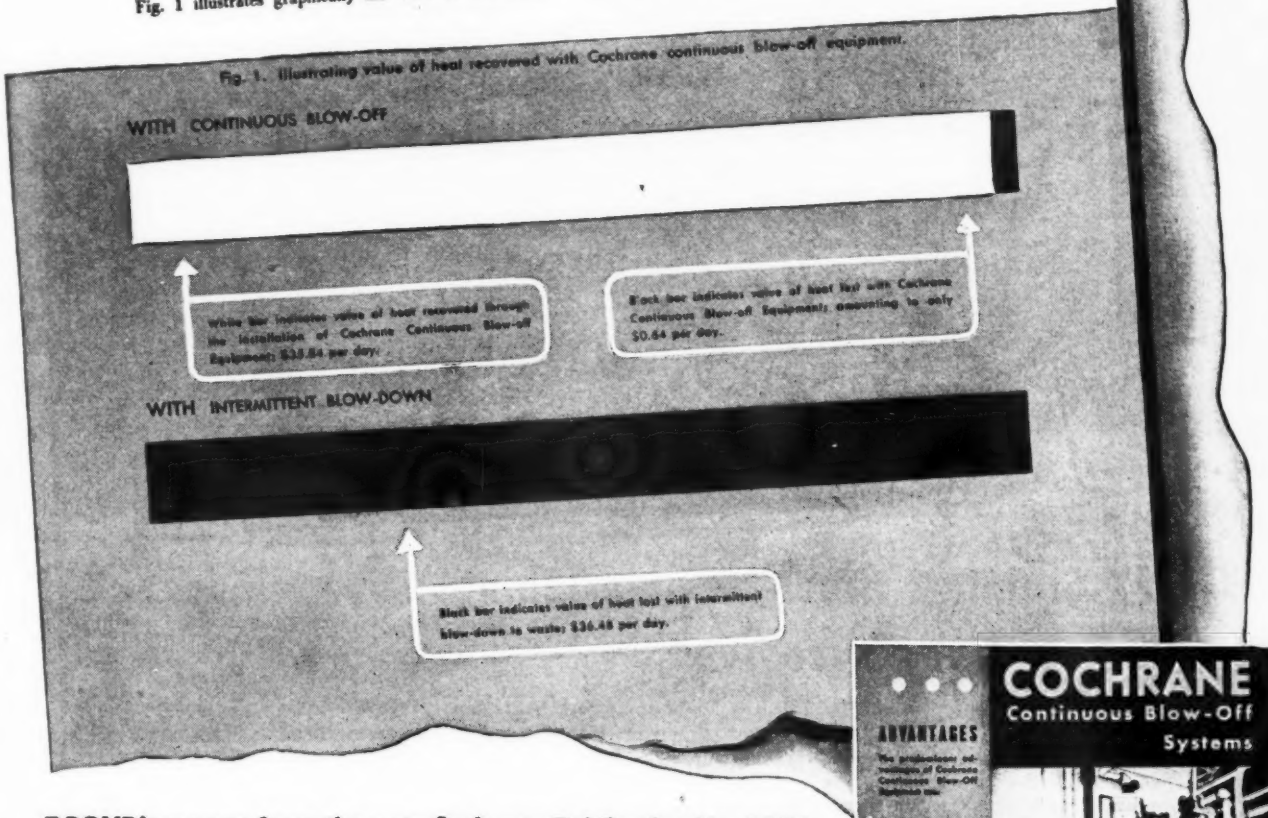
HEAT SAVINGS

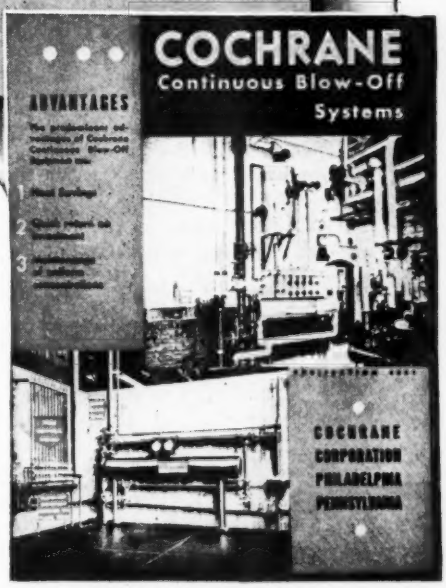
The installation of Cochrane continuous blow-off equipment recovers practically all of the heat in the water, the only heat wasted being that which corresponds to the thermal difference between the incoming cooling water and the blow-off water going to the sewer.

Fig. 1 illustrates graphically the value of heat that would otherwise be lost with intermittent blow-down and the saving that would be brought about by the installation of heat transfer equipment.

The saving brought about by this installation is such that in most cases the cost of the equipment can be realized in a year's time giving a return of 100% on the investment.

Fig. 1. Illustrating value of heat recovered with Cochrane continuous blow-off equipment.


WITH CONTINUOUS BLOW-OFF
White bar indicates value of heat recovered through the installation of Cochrane Continuous Blow-off Equipment: $33.84 per day.
Black bar indicates value of heat lost with Cochrane Continuous Blow-off Equipment; amounting to only $0.64 per day.
WITH INTERMITTENT BLOW-DOWN
Black bar indicates value of heat lost with intermittent blow-down to waste: $36.48 per day.



ABOVE is a page from the new Cochrane Publication No. 4081 on Continuous Blow-Off Systems. The example of savings shown on this page is not at all exaggerated but is based on a representative problem in boiler blow-down. In installation after installation the cost of the Cochrane Continuous Blow-Off System is recovered so quickly that *net* savings often begin inside of a year.

This comprehensive bulletin on the subject of Continuous Blow-Off is just off the press. It will pay you to go over it and see if your present system of boiler blow-down is not wasting money. Write for Publication 4081.

COCHRANE CORPORATION 3106 N. 17th Street PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS • DEAERATING SOFTENERS • DEAERATORS • METERS • STEAM SPECIALTIES

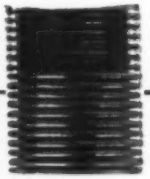
ACID RESISTANCE!

REX-FLEX Stainless Steel Flexible Tubing Is *Non-Corrosive*

REX-FLEX Stainless Steel Flexible Tubing was designed by Chicago Metal Hose Corporation to meet exacting military requirements. Its proved ability to successfully handle many types of corrosive gases and liquids and to withstand extreme heat, makes REX-FLEX equally desirable for the solution of *your* corrosion problems.

REX-FLEX is available in five wall forms, braided or unbraided. Fittings are resistance seam-welded to form uni-metal assemblies.

Why not take advantage of the experience of Chicago Metal Hose Corporation's engineers in adapting this versatile product to the wide range of problems requiring the stamina of stainless steel? They will be glad to give you their recommendations, without obligation. Write for complete information today.



REX-FLEX
STAINLESS STEEL
FLEXIBLE TUBING

Note These Features

- Corrosion resistance
- Extreme flexibility
- Pressure tightness
- Lighter weight
- Withstands extreme temperatures
- High fatigue resistance
- Seam-welded fittings

Flexible Metal Hose for Every Industrial Use

CMH
CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

carries more or less than the 5000 kw.

Incidentally, it is unwise to parallel the small generator when the large one is at zero load, results depending greatly upon characteristics and sensitivity of the turbine governor. When paralleling, as described by PT, the small generator is relieved of practically all surges normally accompanying the synchronizing process, whereas paralleling a 2000-kw generator driven by a 52,000-kw turbine, without stabilizing the unit by a considerable load, sets up surges disastrous to the small machine.

Kalamazoo, Mich. E E NORMAN

Power Divides In Fixed Ratio

TWO AC GENERATORS driven on one shaft and connected in parallel divide the power between them in a fixed ratio. Changing the excitation of one machine changes the circulating current between the two machines. If the smaller machine has closer regulation or lower reactance than the larger it may take more than its share of the load.

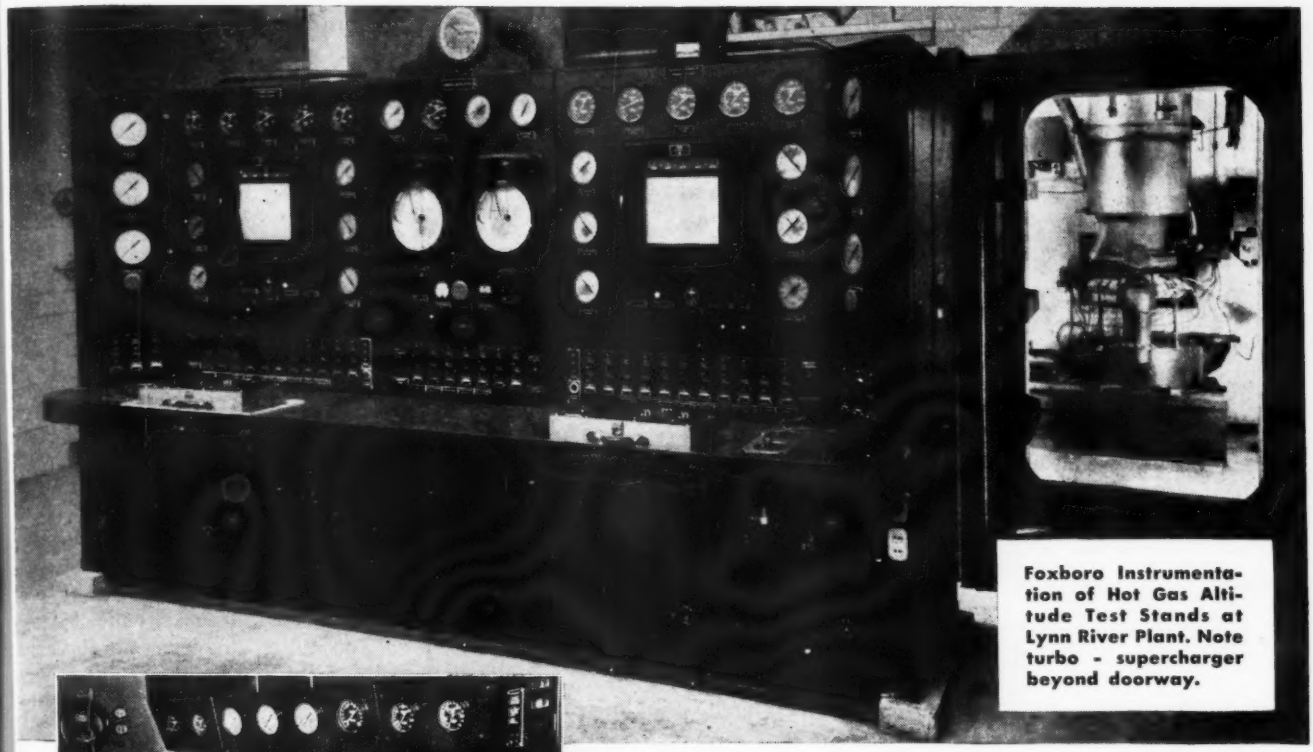
If one machine is star and the other delta connected, it is necessary to have a mechanical displacement between the poles of the two units to allow them to parallel electrically. It is likely that both machines are star connected and that the station service transformers are star connected on the 13.000-v side and delta connected on the 2300-v side. Either condition would result in a 30-deg electrical shift of poles of one machine with respect to the other. This would be a mechanical shift of 30 deg on a 2-pole and 15 deg on a 4-pole machine.

When dismantling the generators take these precautions: (1) Mark ac leads of both generators so that they are connected exactly as before. (2) Mark dc leads because a reversal of excitation of one machine would result in a short circuit when paralleling the last generator. (3) Mechanical positions of one rotor with respect to the other and of one stator with respect to the other must be maintained. (4) If stator windings are replaced, a phase group must start in the same slot and proceed as in the original winding. (5) All internal ac and dc connections must be marked. (6) Any change in connections of the external circuit comprising generator oil switch, spur bus, local service transformers, station service bus and air circuit breakers results in a short circuit. (7) Take care to compare phases across an open switch before paralleling.

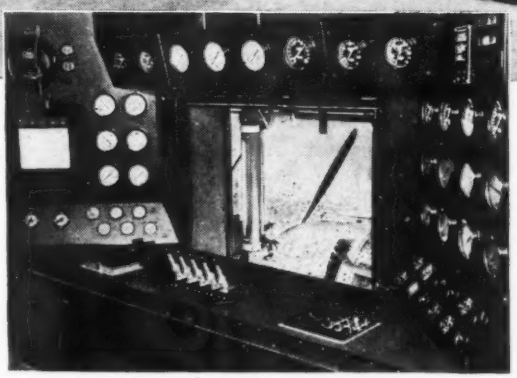
Boise, Idaho RUSSEL WOOD

(*Continued on page* 180)

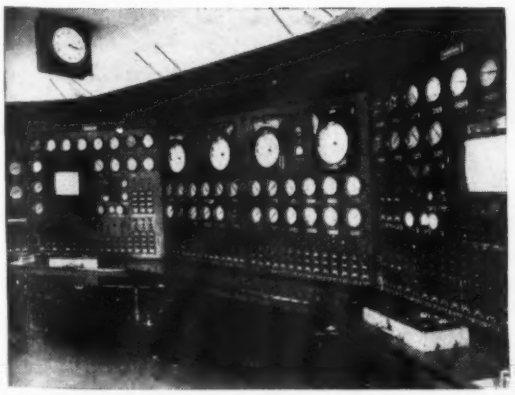
FOR PRECISION
in Turbo-Supercharger Testing...



Foxboro Instrumentation of Hot Gas Altitude Test Stands at Lynn River Plant. Note turbo - supercharger beyond doorway.



Control board for Airplane Power Plant . . . one of 7 Foxboro-equipped test cells at General Electric's Lynn Plant.



Hot Gas Altitude and Refrigeration Control Board completely equipped with Foxboro Dial Indicators, Potentiometer Recorders and Stabilog Controllers.

Foxboro Instruments equip test-stands at General Electric Co.!

For the important job of designing and improving airplane turbo-superchargers, seven altitude test-cells have been set up at the Lynn River Plant of General Electric Company. To insure utmost precision in measuring and controlling atmospheric conditions that duplicate those at 50,000 ft., and down to −100° F., these cells are fully-equipped with Foxboro Instruments.

This is but another example of modern engineers' preference for Foxboro in close control jobs. The majority of today's airplane engine builders also use Foxboro Instruments on their test stands.

In your process instrumentation, too, Foxboro's experience can help you obtain best results. Write your problems to **The Foxboro Company, 68 Neponset Avenue, Foxboro, Mass., U.S.A.** Branches in principal cities.

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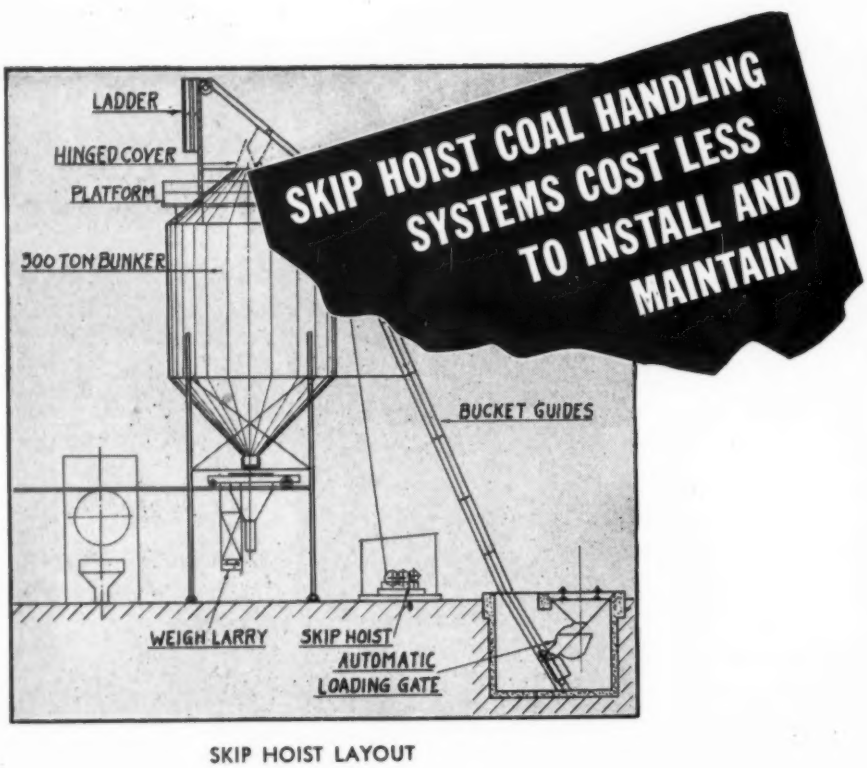


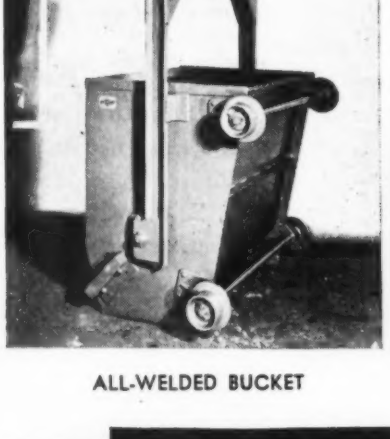
SKIP HOIST LAYOUT

WEIGH LARRY INSTALLATION

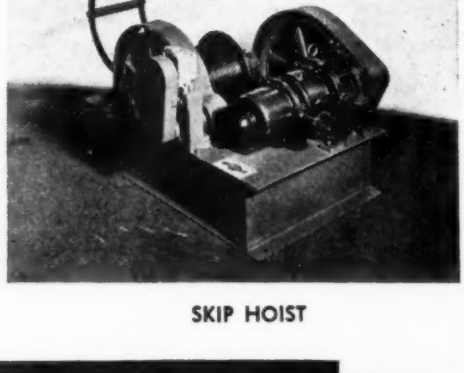
Simplicity of design and equipment in a skip hoist makes it less expensive to install, helps lower first cost. Maintenance expense, too, is very small.

Gifford-Wood skip hoists are ideal for handling heavy, abrasive and bulky materials containing large lumps as well as fine particles. Machines may be arranged for alternate hand control, semi-automatic and full automatic operation.

Catalog with complete data on a full line of G-W skip hoists will be sent on request. Ask for Catalog 200.



ALL-WELDED BUCKET



SKIP HOIST

GIFFORD-WOOD CO.

FOUNDED 1814

New York: 420 Lexington Ave. HUDSON, N. Y. Chicago: 565 W. Washington Street

5766

Lines Overloaded

WH WILL PROBABLY find his trouble comes from one of these causes or a combination of them:

(1) Hammer takes place in pipelines when they carry too much condensate. (2) Condensate accumulates in pipelines when they do not have sufficient pitch, when drip points are too far apart, when lines sag or when steam flows at too high a rate counter to condensate flow. (3) A single pipe heating job may operate quietly in mild weather but become quite noisy when heavily loaded in cold weather.

Columbus, Ohio IRA A BUTCHER

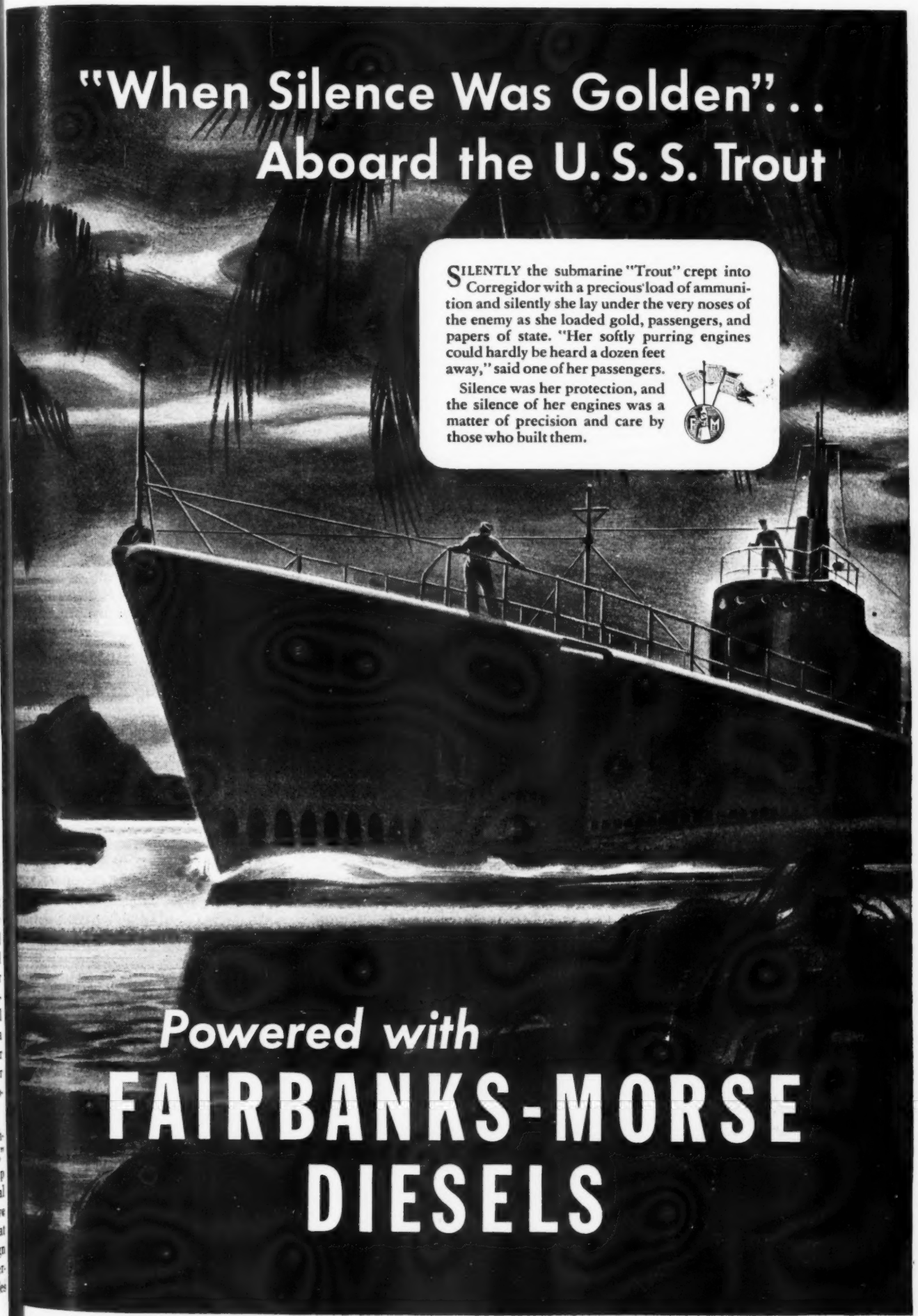
Engineers' Meeting

(*Continued from page* 101)

Operation of generating plants and energy interchange within the group and with adjoining systems comes under a central supervisory group that works with the load dispatchers of individual companies. This group makes arrangements to load and unload steam units to utilize, supplement or conserve hydro flow; provide outage for inspection, maintenance and emergencies of steam and hydro units; and insure free hydro-regulating capacity for tieline control, spinning reserves and minimum flows. The group also arranges to receive and deliver energy to outside sources and synchronize these transactions with hydro and steam operations on the system.

Fuels "A Study of Stoker Fuel Beds," presented by Otto de Lorenzi, Combustion Engineering Co, included a showing of speed-up movies of burning fuel beds. This method of studying stoker action permits reproducing every detail and sequence of operation and shows coal behavior in each fuel-bed zone. Knowing how fuel acts under given conditions helps the plant operator get better results, gives the fuel supplier a keener appreciation of why a certain coal is best for a particular operating condition and helps the stoker engineer make adjustments that produce the most economical results.

Pumps "Certain Aspects of High-Pressure Centrifugal Pumping Cycles," by Igor J. Karassik, Worthington Pump & Machinery Corp, reviews centrifugal pumping cycles to show how they have influenced pump design and to what extent practical limitations of design influenced the cycles themselves. Boiler-feed and forced-circulation-boiler cycles


"When Silence Was Golden"...
Aboard the U. S. S. Trout
SILENTLY the submarine "Trout" crept into Corregidor with a precious load of ammunition and silently she lay under the very noses of the enemy as she loaded gold, passengers, and papers of state. "Her softly purring engines could hardly be heard a dozen feet away," said one of her passengers.
Silence was her protection, and the silence of her engines was a matter of precision and care by those who built them.
Powered with
FAIRBANKS-MORSE
DIESELS

served as examples of pump hookups.

Mr Karassik included numerous diagrams explaining these feedwater cycles: simple system, straight condensing, heating with exhaust steam, condensing with bleed heating, multiple direct-contact heaters and multiple closed heaters. Other interesting features were characteristic curves of a constant-speed pump working against a feedwater regulator, Fig. I, and how a varying hot-well-condensate level affects pump output.

This paper is a small textbook on pump design, showing the steps to solve problems arising from high pressures and temperatures in the many different boiler-feed cycles.

J D Scoville, S Morgan Smith Co, in "Adjustable Blade Pump Installations for Drydock Unwatering," described recent axial-flow pumping installations for heavy-duty work. Four 1250-hp pumps were installed in one drydock and three 1500-hp units in another.

Problems Encountered

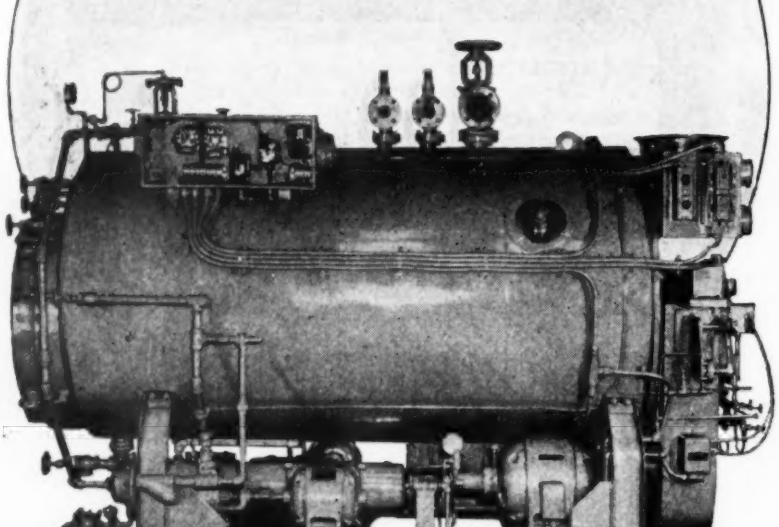
Interesting problems encountered in these installations were: (1) Each pump group had to remove 60 million gal of water in 160 min, equivalent to 375,000 gpm; head varied from 15 to 55 ft. (2) Necessity of reducing the discharge when water was only 2 ft deep to prevent unwatering faster than water flowed down the dock to suction pit. Adjustable blades give good control of discharge until the dock floor is practically dry.

The adjustable-blade pump benefits from the deep submergence at start of pumping and offers the further advantage of maintaining a constant load to use the motor's full capacity over the entire range. This is done by wattmetric control which reduces blade pitch as the dock water level falls.

Pump-motor starters will not operate unless sluice gates are open and impeller blades are at minimum pitch to prevent building up high shutoff pressure and overloading of the motor. These conditions being satisfied, pump motor starts and synchronizes. Next, pump blades are opened by manual control to 10% capacity. Control is then thrown over to the wattmetric device which automatically increases the blade angle to fully load the motor.

As the dock water level falls, the wattmetric control compensates for the increasing head by decreasing the blade angle to hold a constant motor load. When water level falls to two feet, blade control automatically cuts away from the wattmetric device and the blades are then operated by manual control for final unwatering.

DOLLAR EFFICIENCY—
work done per dollar spent measures the value of steam generation



A Cyclotherm Generator that produces 4,000 lbs. of steam per hour

Hundreds of Cyclotherm Steam Generators in a wide range of horsepower have proved they can "take it" and deliver under all kinds of wartime conditions.

The Cyclotherm steam generator shown here, built for the United States Navy, is ruggedly constructed for heavy duty purposes. This unit is fired with Bunker C oil and produces 4000 pounds of steam per hour.

All Cyclotherms are fully automatic, completely self-contained and adaptable to processing, power or heat. The wide use of these generators has proved their unusual steam producing capacity per unit of fuel consumed. Cyclotherm's exclusive principles of combustion and design insure high efficiency at low operating costs.

Cyclotherms may be operated for years with a minimum of attention for they are designed and built to deliver efficient, trouble-free automatic service under exacting conditions.

They are manufactured in units from 10 to 300 horsepower, oil or gas fired. Deliveries are being made as rapidly as the press of Government orders permit. While the range of available units obviously cannot be on a peacetime basis, if you are planning immediate replacement, our engineers will be glad to cooperate in meeting your needs. We shall be happy to supply any additional information you may desire.

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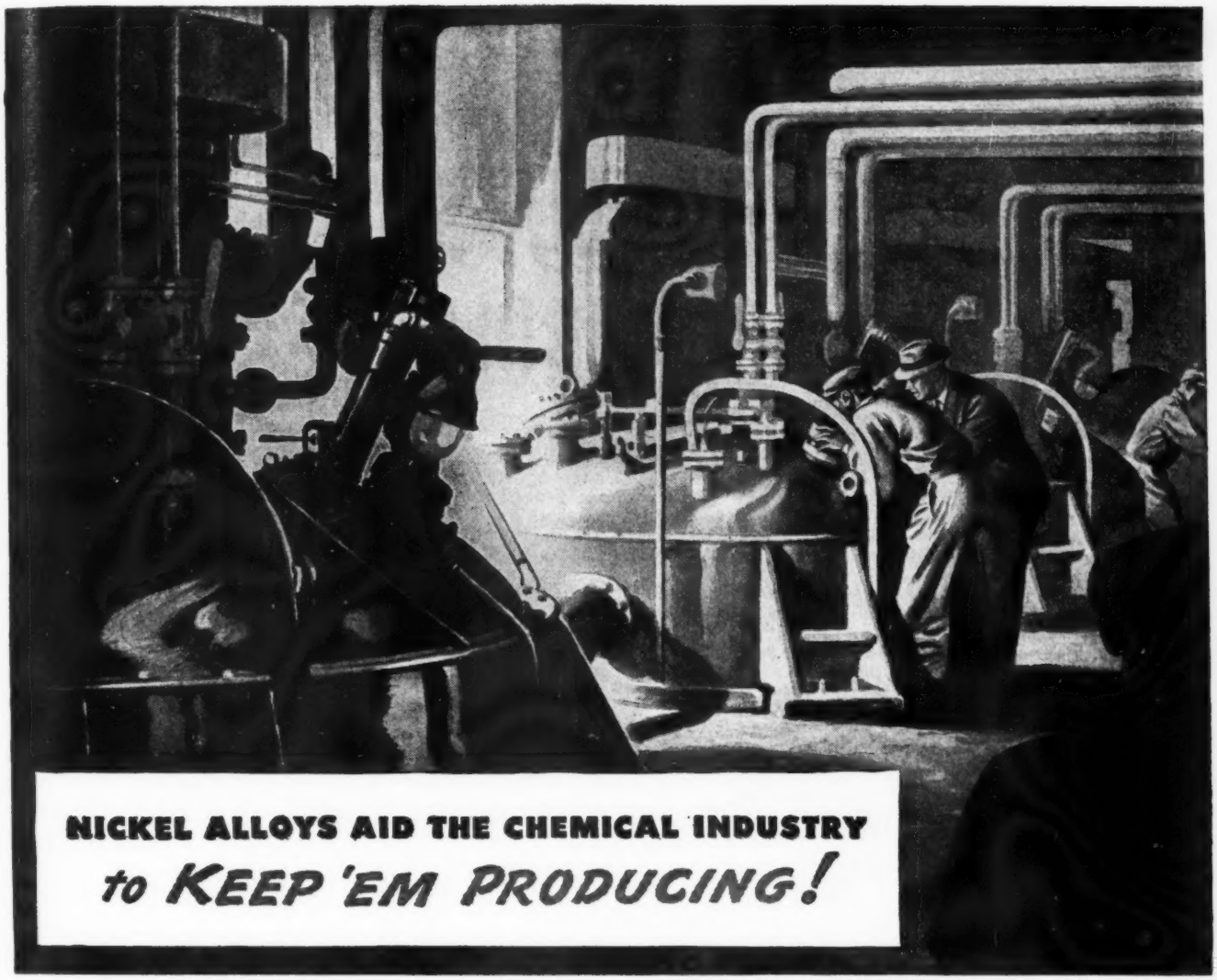
STEAM GENERATOR

AMES IRON WORKS
OSWEGO . . NEW YORK . . BOX 302



NICKEL ALLOYS AID THE CHEMICAL INDUSTRY to KEEP 'EM PRODUCING!

Stainless Steel Lined Polymerization Reactors in Synthetic Rubber Plant

Equipment of Stainless Steel, Nickel and Monel meets many specialized requirements

Chemical engineers have met America's wartime challenge.

They opened the gates to a mighty flood of products going to war...strategic raw materials, synthetic substitutes, and entirely new substances having advantages all their own.

A factor in this production success is the wide use of stainless steel, Monel, and other corrosion-resistant alloys containing Nickel.

For in the chemical industry corrosion is a large-scale menace.

To wage war on this enemy, chemical engineers enlisted the aid of Nickel, because Nickel imparts to other metals strength and resistance to corrosion and wear. In the chemical field, as in many others, a little Nickel goes a long way to keep equipment producing.

It prolongs the life of processing apparatus, and protects the purity, color, and uniformity of the product.

Hence, stainless and Nickel alloys are specified widely for acid heaters and caustic coolers, for high-pressure autoclaves and vacuum evaporators, for cracking towers and polymerization reactors, for shipping drums and tank cars, for pumps, piping and storage tanks, for agitators and settlers, for stills and digestors—for every type of equipment that converts laboratory experiments into full-scale chemical operations.

For years we have enjoyed the privilege of cooperating with technical men of the chemical industry...and of many others. Whatever your industry may be ...if you want help in the selection, fabrication, and heat treatment of alloys . . . we offer you counsel and data.

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Mercoid has served the nation's peacetime control requirements for more than two decades. During these years, experience has demonstrated the correctness of the design and operation of Mercoid Controls. Their record of accurate and dependable performance is the basis for their wide acceptance among engineers planning America's essential wartime production.

The "familiar" DA type control shown above, is a favorite with industry. The outside double adjustment feature and direct reading simplifies the setting and eliminates all guesswork, an important factor considering new help in all plants.

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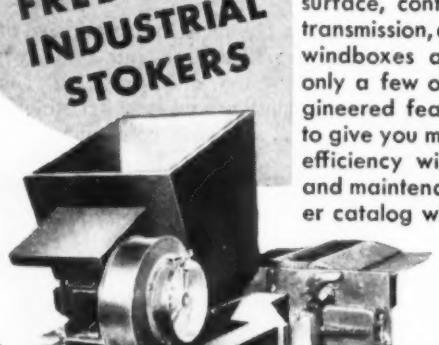

HOPPER OR BIN FEED
200 to 850 LBS. PER HOUR
Clinker type, or Side Dumping Grate, Hopper or Bin Feed Models.

THE Frederick IRON & STEEL CO.
Frederick, Maryland

Diesel MEP and HP

(*Continued from page* 79)

Follow the same procedure in laying out the vertical scale, calling the first point, which is one on the slide rule, 10 psi, the next point 15, than 20, 25, etc. When 100 is reached, the scale is repeated; this time the points are 100, 150, 200, etc.

Next divide the indicator diagram into volume units, as in Fig. 6. It is not necessary to divide the volume dimension into units representing the actual cylinder volume, but the division may be into tenths or parts of one hundred, making the total diagram volume, *plus the clearance volume*, equal to unity, or to 100.

It is necessary to have the clearance volume exact, or the logarithmic diagram will be worthless. In vertical engines with a straight combustion chamber, the linear dimension represents the clearance volume closely enough. In many cases the clearance volume is given by the manufacturer along with other engine data and this figure is satisfactory unless the shimming under the rod foot has been materially changed. On engines with irregular combustion chambers, measurement may be necessary. This may be done by putting the engine on dead center, placing wax about the piston top to prevent leakage along the piston and filling the combustion chamber with water from a weighed bucket. Reweighing the bucket gives the amount of water used, and dividing the difference in weight, in lb, by 62.4 gives the clearance volume in cu ft.

Next step is to read the pressure at each division point on the expansion and compression lines of the card, transferring these readings, in psi, to the logarithmic chart. If the plotting has been done accurately, the compression and expansion lines will be straight on the logarithmic diagram. If the expansion line shows an angle, as in line *abc*, it may be assumed that there is some afterburning. Engineers, who find that exhaust temperatures are running high or that exhaust valves burn, will discover upon such transformation to the logarithmic paper that the expansion lines are bent, showing afterburning.

Steam "delivered" by N. Y. Central Railroad keeps the Frontier Linen Supply Co., Buffalo, N. Y., in operation after a breakdown. A locomotive, stationed on a siding, was connected with the pipes to the laundry's steam lines. Then, just stoking the locomotive boiler kept up steam pressure.

Only HENDY DIESELS Combine all these Features!

TOMORROW'S DIESEL TODAY

GENERAL SPECIFICATIONS
SERIES 50

Bore—12"; Stroke—15"
Speed—350 to 600 RPM
Rated Power at 450 RPM—
75 hp. per cyl.

Write for complete data on the Hendy Series 50 Diesel Engine

- Unit-type fuel-pump injectors
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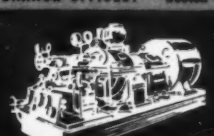
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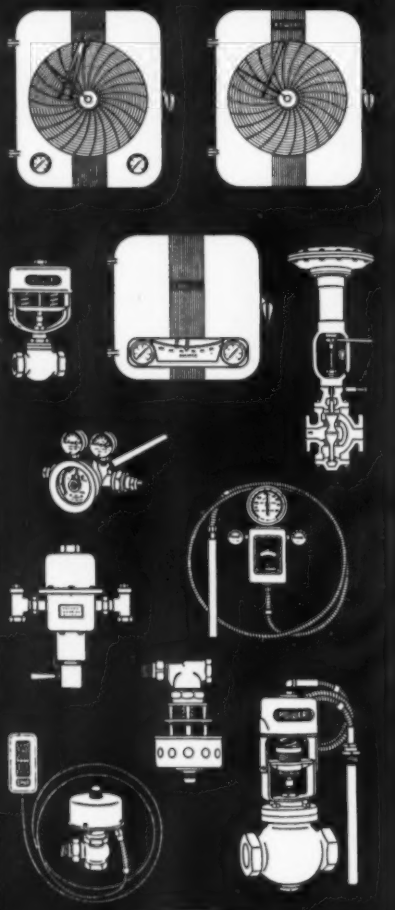

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Offices in 47 Cities—See your phone directory.

THE
POWERS REGULATOR CO.

Dissolved Oxygen

(*Continued from page 76*)

ences in emf for unit additions of thiosulphate are proportional to the slope of the titration curve. Data for such a curve can be formulated by dividing the increment of change in emf by the increment of sodium-thiosulphate addition and plotting those values against the total sodium thiosulphate used at each point. An illustration of a typical titration curve is shown in Fig. 2.

Accuracy of titration is largely dependent upon proper selection of potentiometer or voltmeter. It is not necessary that the instrument read emf as the method of use of the data obtained is based upon differences in potential and actual voltage values are of little or no use in the final analysis. It is essential that the instrument read pH, emf or any other unit which corresponds to an actual emf range of from 100 to 500 millivolts and that the scale be a linear function of emf. It should be accurate to an equivalent of one millivolt and have a galvanometer or other indicating device which is easy to balance or read. One type of instruments well suited to this purpose is the vacuum tube voltmeter with electronic compensation which requires no balancing or adjusting during titration. The meter shown in Fig. 3 is this type and is suitable for the purpose of the particular titration described. The one illustrated has been improved by adding an auxiliary circuit which doubles the scale deflection for a given change in emf.

With proper selection of instruments and apparatus it is possible to conduct any of the modified Winkler tests with a high degree of accuracy. Experience has shown that great care must be exercised in conducting the tests and that the actual test procedure is of great importance. Many chances for error exist and the final development of a reliable test procedure has been a long and arduous task.

Editor's Note: Part II of Mr Sebald's article discussing development of reliable test procedures will appear in June POWER

Office of War Utilities granted **AA-3** ratings for seven steam turbines and generators, to bolster local systems. Units are to operate late this year and early in 1945—two in existing power systems, five in industrial plants. Largest is a 40,000-kw unit for Boston Edison Co.

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RECORDS

Porous Castings

When this casting became leaky, a putty of SMOOTH-ON No. 1 was hammered into the visible pores or openings, and allowed to harden. To fill the remaining pores, a paste of SMOOTH-ON No. 3 was painted over the porous area on the pressure side, and the casting was again ready for service.

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Buy SMOOTH-ON in 7-oz., 1-lb., or larger containers from your supply house, or if necessary from us. For your protection, insist on SMOOTH-ON, used by engineers and repair men for over 45 years.

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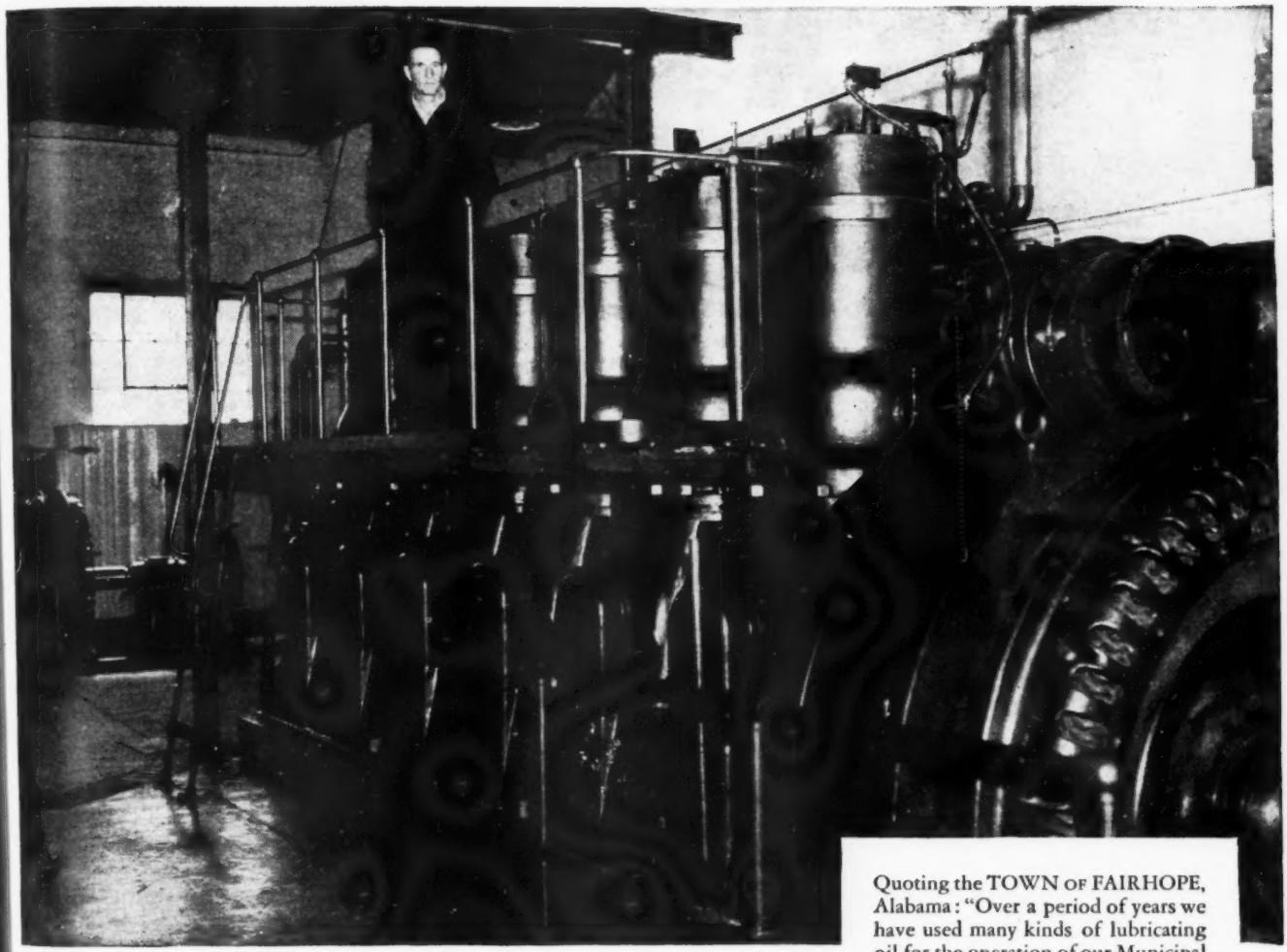

Quoting the TOWN OF FAIRHOPE, Alabama: "Over a period of years we have used many kinds of lubricating oil for the operation of our Municipal Light Plant," says Fairhope's Chief Engineer, "and to anyone who wishes the best in lubrication, I recommend Macmillan RING-FREE Motor Oil. . . . Since we changed over to Macmillan RING-FREE, we never have any stuck rings, hard carbon formations, etc. . . . In addition to perfect lubrication and freedom from mechanical difficulties, a check of our fuel records shows a saving of over a cent per kilowatt hour in the Diesel fuel consumed."

Again and again engineers report performances they're proud of on Diesels lubricated with Macmillan RING-FREE Motor Oil. Every Horse Power Hour delivers more usable power—dependable power—for the simple reason that RING-FREE reduces friction *fast!*

And Macmillan RING-FREE will remove carbon while your engine runs! Changing to RING-FREE means getting a motor that has to run sweeter as it benefits fully from rapid, thorough penetration. You get high film strength, high heat resistance and long cling from RING-FREE.

Macmillan representatives welcome your trial and comparison of RING-FREE on the basis of complete records of operating performance and economy!

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—with FYR-FEEDER Multiple SPREADER Stokers

FYR-FEEDER stoker firing not only saves coal, but also permits you to burn any kind of wet or dry bituminous coal you have available locally—screenings or sweepings, any melting point of ash, free-burning or coking coals.

Burns Coal like Oil: FYR-FEEDER burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed. Thin fuel bed—no clinkers. Fires can be cleaned in two minutes! Suitable for large or small boilers. Very little maintenance cost. In many cases FYR-FEEDER stokers have made it unnecessary to add another boiler to handle increased loads.

FYR-FEEDER is our own original design. FYR-FEEDER is not a copy of any other stoker but our own invention developed by us, and our engineering experience with spreader stoker design, installation and operation began in the last century.

WET COAL IS NO HANDICAP

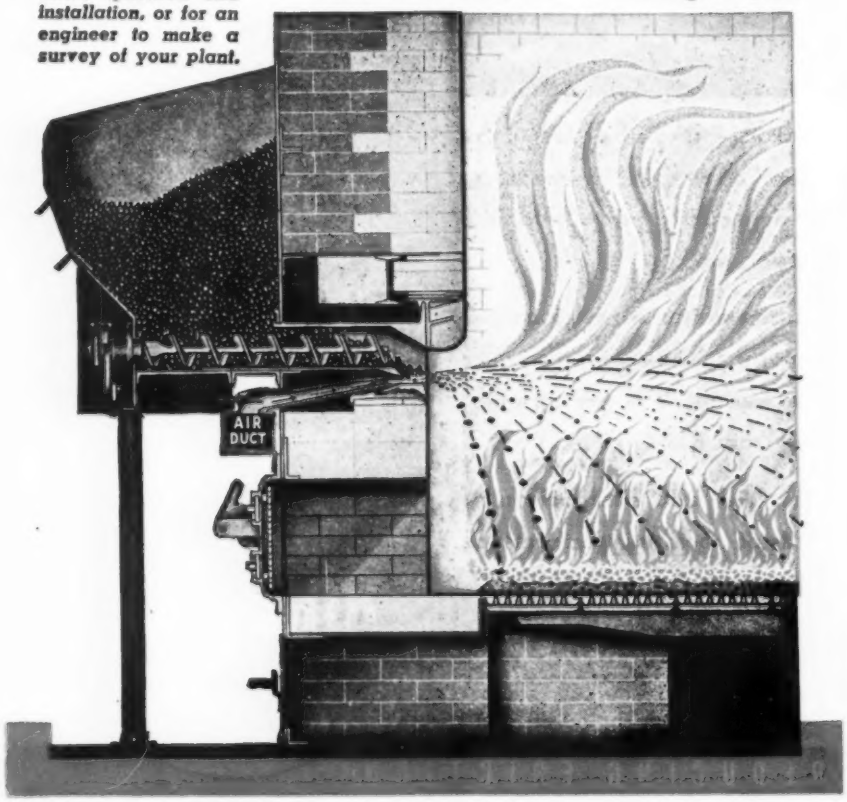
Coal men like the FYR-FEEDER because FYR-FEEDER users do not insist upon the delivery of "DRY" coal since FYR-FEEDER handles "WET" coal satisfactorily. Regardless of "rain and snow watered" coal, FYR-FEEDER stokers produce plenty of steam from "WET" coal. FYR-FEEDER was designed to use "WET" coal or dry coal.

AMERICAN COAL BURNER COMPANY

—Engineers—

WRITE FOR CATALOG describing features, operation and installation, or for an engineer to make a survey of your plant.

22-18 E. Erie St. Chicago 11, Ill.



Power News

(*Continued from page* 130)

Two dams, a tunnel, powerhouses and other structures of the $19,650,000 City of Tacoma, Wn, project are about three fourths completed. Its power output of 40,000 kva will help make up for the inadequacies of power for Northwest war industries. For postwar production, 75,000 more kva are scheduled. Project is on the Nisqually River, 30 miles from Tacoma, and is financed by municipal funds.

General Cable Corp containers have been shipped on a no-charge basis since March 1. They allow credit for all containers, which have been billed and paid for, provided they are returned in good condition by Feb 28, 1945. After that, no credit will be allowed on returns. This plan will undoubtedly receive everyone's support since it eliminates costly, time-consuming methods.

Vice Admiral S M Robinson, chief of procurement and material, executive office of the Secretary, U. S. Navy, received an honorary degree of Doctor of Engineering from Stevens Institute of Technology.

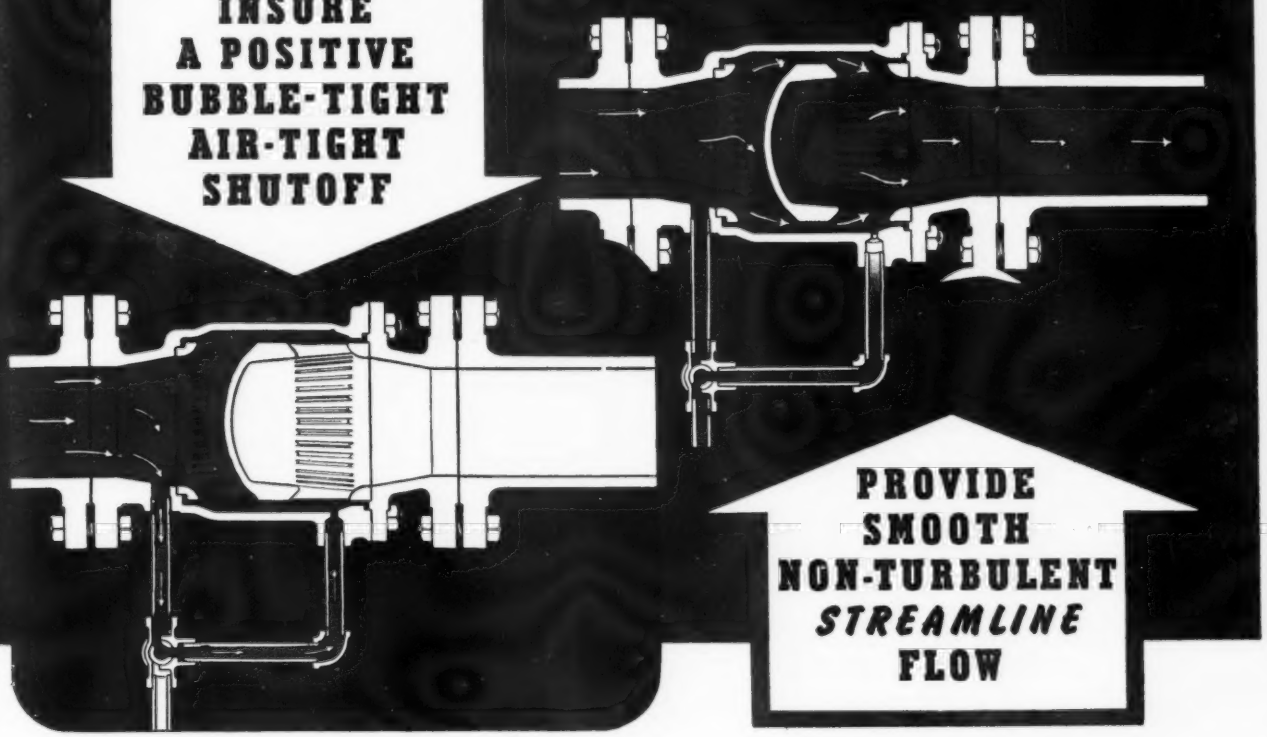
Stevenson Association, No. 44, New York, NAPE, will celebrate its 50th anniversary on May 19. Organized in 1894 with eight charter members, it has grown with the years to its present membership of more than 400. Founded for the purpose of securing the passage of engineers' license laws and for the development of the members' abilities in their chosen profession, education has always been a cardinal tenet of the Constitution. The Association later took a leading part in the formation of a representative body termed the General Committee, which sponsored lectures and debates and ran efficiency tests in the steam plants of the city.

No. 44's members have held high office in both state and national bodies and have always been a factor in the decisions made at national NAPE conventions. They have given generously of themselves, in both World War I and the present struggle. Stevenson Association looks forward to the next half century of fruitful service, basing its plans on the guiding principle that made its first 50 years so successful—"the greatest good for the greatest number and equal justice for all."

Instalment buying of equipment promises to contribute to postwar reconversion and expansion. Its extensive use will make it possible to pay for equipment out of income it helps produce. This lightens the purchaser's burden and enables the financing agency to carry a minimum risk during the payout period because of systematic debt reduction. These findings are included in a report, *Financing Equipment for Commercial and Industrial Enterprise*, by Professor N H Jacoby, Univ of Chicago, and Professor R J Saulnier, Columbia University, published by Natl Bureau of Economic Research, 1819 Broadway, New York City.

GROVE *FLEX-FLO* REMOTE CONTROL VALVES

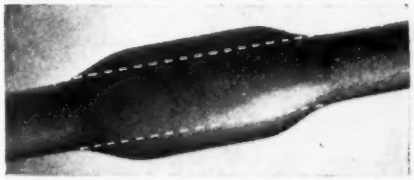
INSURE A POSITIVE BUBBLE-TIGHT AIR-TIGHT SHUTOFF



PROVIDE SMOOTH NON-TURBULENT *STREAMLINE* FLOW

The Grove Flexflo Valve utilizes just one NON-METALLIC moving part. It employs no seats, discs, springs or weights—nor any packing gland, stuffing box or exposed members. Existing fluid pressure in the line, forces the flexible tube to fully expand against the inner wall surface of the encasing valve body—permitting a smooth non-turbulent streamline flow. Pressure diverted from the upstream line to the actuating chamber around the tube, by remote control, establishes a pressure balance on the inner and outer walls of the expansible tube. The valve then contracts to its closed position, providing a positive bubble-tight, air-tight shutoff. There is never the slightest possibility of sticking, freezing, or leakage due to wear. Flow capacity is considerably greater than that of conventional globe type valves on the same pressure drop or loss. For full descriptive details, write for Bulletin 800.

EXPANDS TO OPEN



CONTRACTS TO CLOSE

BY REMOTE CONTROL

G-R-O-V-E *FLEX-FLO* VALVES

GROVE
SIMPLICITY
ACCURACY
SAFETY

GROVE REGULATOR COMPANY
6547 GREEN STREET, OAKLAND 8, CALIFORNIA. *Branch Offices:* 30 Rockefeller Plaza, New York 20 • 5644 Navigation Boulevard, Houston 11, Texas • 1930 West Olympic Boulevard, Los Angeles 6, California

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It's "NICHOLSON"

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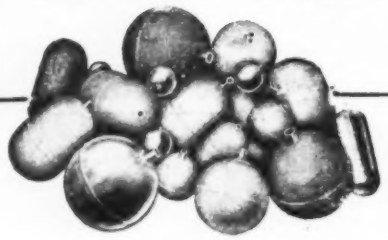
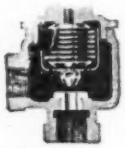
TRAPS • FLOATS • VALVES

for Every Purpose





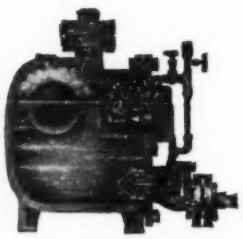
THERMOSTATIC INDUSTRIAL TRAPS—Five types; sizes ¼" to 2"; 2 to 6 times greater valve area; pressures to 225 lbs.

NICHOLSON Steam Traps, Floats, Valves and other control devices are today being put into use by representative firms in every major line of American industry—conclusive proof of their superior features.

FLOATS, above, are made in all shapes and sizes.

CYLINDER CONTROL VALVES—2, 3, and 4-way types for single and double-acting cylinders. Pressures to 5,000 lbs. For air, steam, water, oil, etc.

SEND FOR BULLETINS
See Our Catalog in Sweet's



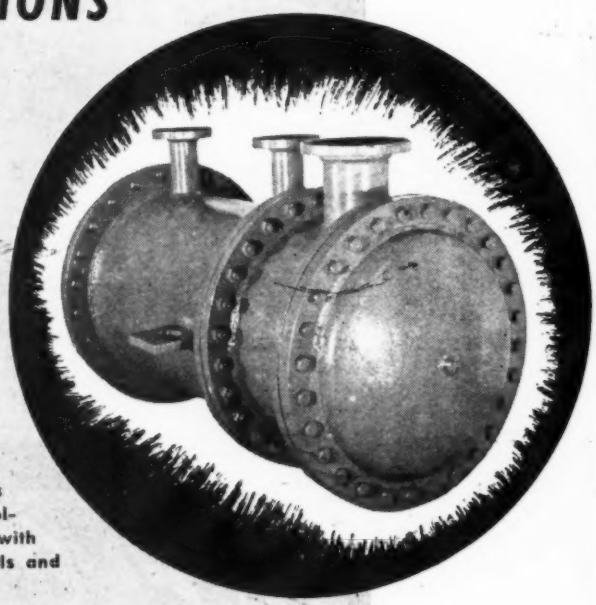
PISTON-OPERATED STEAM TRAP—High pressure model with non-wire-drawing discharge valve. For pressures to 650 lbs. . . . one of a variety of modernly designed "operated" traps for many uses.

W. H. NICHOLSON & CO. 125 Oregon St. Wilkes-Barre, Pa.

HEAT EXCHANGERS TO YOUR EXACT SPECIFICATIONS

In recent months DOWNINGTOWN has DESIGNED and BUILT units for the following unusual duties, as well as hundreds of heat exchangers, oil coolers, etc. for simpler applications:

Cooling complex mixed gases with water. Condensing organic vapors (alcohols, solvents) with steam. Cooling methyl alcohol with boiling Freon. Cooling complex mixed gases with boiling ammonia. Cooling diesel jacket water with crude oil. Write for details and literature.



Repeat orders were over 70% of DOWNINGTOWN'S 1942-3 business

HEAT TRANSFER DIVISION
DOWNINGTOWN IRON WORKS • DOWNINGTOWN, PA.

REPORT ON COAL

Bureau of Mines is investigating wider use of anthracite *fines* to reduce the annual million-ton surplus and to relieve shortages in other fuels. Possibilities will be explored of mixing more **anthracite fines**—No. 3 and smaller—with bituminous in briquettes to replace low-volatile coal in byproduct coke ovens and in gas producers that normally use larger anthracite sizes.

Recent Bureau tests showed that mixtures of anthracite *barley* and bituminous slack burn in underfeed stoker equipment about as efficiently as straight bituminous. Anthracite fines are slow moving, and the piling up of supplies delays production of larger sized anthracite for domestic use.

The Bureau's engineers will consider whether an increase in anthracite quantity in the briquetting industry is feasible, and whether idle and new-type equipment can be used. They will investigate whether some building brick-making equipment, not used at certain seasons, can be employed in pressing fuel briquettes.

Gas-producer experiments will ascertain whether a mechanical agitator in the fuel bed will permit burning smaller sized anthracite than now used, while maintaining the same capacity.

In the coke-oven field, the Bureau will extend private industry's research in substituting anthracite fines for part of the low-volatile bituminous, since a continuing serious shortage, particularly of central Pa. low-volatile coal, is predicted.

Solid Fuels Adm has been considering revision of regulation 10, governing coal for industrial users. Only restrictions on coal in districts where supply of **bituminous coal** has increased would be in limiting holders of 120 days' supply, or more, to their monthly burn. No relaxation was expected in districts 1 - 8 and 13.

Deputy Solid Fuels Adm Potter predicted a shortage this year of 20,000,000 tons of bituminous. He said regulation 10 would remain in effect with possible amendments to allow stockpiling where excess coal becomes available and warned that users with deficits will receive a "cool welcome" if they have refused substitutes.

U. S. coal-mine employment has dropped to the "rock-bottom level" capable of insuring 1944 production goals. Bituminous employment dropped by 45,000 men during the year ended Jan, 1944, leaving only 392,000 men at work. Average miner's age rose from 32 to over 40, and losses from super-annuation this year are expected to reach 20,000 to 25,000 men.

Recruitment drives will be conducted in areas to which miners are known to have migrated and among mines not operating full time. Referrals will be made to most efficient mines, and area stabilization programs will be strengthened where necessary to halt out-migration.

The bituminous coal industry has 40,000 deferred young men—10% of its labor force.

Manufacturers of pulverized-coal equipment met recently with a committee of Bituminous Coal Research, Inc, of

What's Behind the Trade Mark?

QUALITY

TRADE MARK

YOUNGSTOWN

SERVICE

Additions and Improvements for Greater Service

IN the five worst years of the Depression -- 1931 to 1935 -- The Youngstown Sheet and Tube Company spent over twenty-nine million dollars for "additions and improvements." Specifically, this meant new electric weld tube mills, improvements to seamless tube mills, new 79" continuous hot and cold sheet and strip mills, new alloy steel facilities, new thin wall conduit mills, new tin plate mills, blooming mill furnaces, railroad spike and tieplate plants, river coal loading equipment, ore mine improvements and many other projects to improve quality and further to diversify products.

How could Youngstown afford to invest so many millions in new equipment when the economic world seemed desperate? Because of two vitally important things: First, because the company had been permitted -- under a system of free enterprise -- to earn and conserve profits which *could* be spent in bad times. Second, because under free enterprise the company could look forward with certainty to business recovery, when America would need vast quantities of steel again and would reward those producers who had the most efficient plants.

Typical of industries created and reared by Free Enterprise, Youngstown can continue to improve quality and further to diversify its products with additions and improvements, so long as enterprise remains free.

Historical Series - - - No. 12

TAPPING HEAT OF OPEN HEARTH STEEL

YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOY STEELS

Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate
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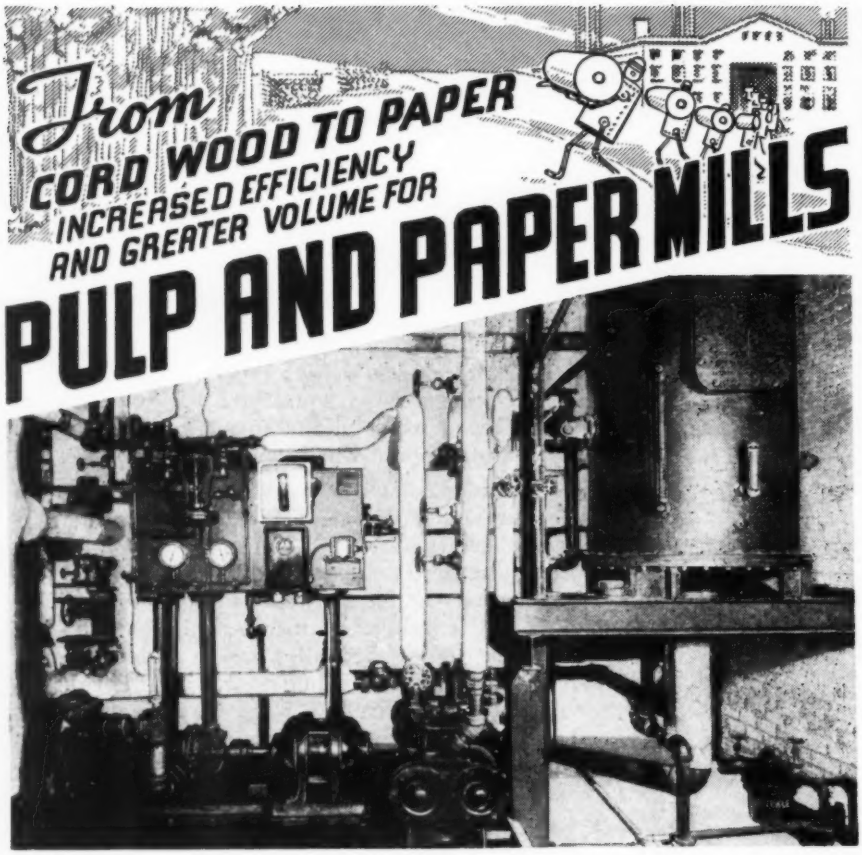


Stickle steam specialties have had an important part in increasing the efficiency of paper and board mill production, improving quality and reducing manufacturing costs. Stickle Equipment, installed to meet requirements of individual mills, is used for drainage and control on the majority of paper mills in United States and Canada.

In one corrugated paper mill, the Stickle Differential Drainage and Boiler Return System—installation illustrated—raised temperature of condensate returned to boilers from 210 degrees to 310 degrees. This conservation of B.T.U.s in condensate is reflected in reduced fuel consumption and increased boiler capacity. It is obtained by returning condensate from the corrugating equipment to boilers, under pressure, at a temperature only 15 to 20 degrees lower than the temperature of steam at operating pressure. In addition the system assures correct and positive drainage of the corrugating units, which increases production volume. It also eliminates high velocities and reduces scale, decreasing maintenance costs.

Stickle Differential Drainage and Boiler Return System is obtaining equally satisfactory results in other types of industry using medium or high pressure steam for processing operations such as canning, milk drying, laundry, etc. Fuel saving increases with higher operating pressures.

Other Stickle Equipment widely used in industry generally as well as in the paper field are Open Coil Feed Water Heaters, Open Float Steam Traps, for all working pressures, Regulating and Reducing Valves, Temperature Controllers and Triplex Oil and Steam Separators.

BULLETINS ON REQUEST: No. 250—Complete information on Stickle Differential Drainage and Boiler Return System. No. 117—Open Coil Feed Water Heaters and Purifiers. Nos. 115, 315, and 515—Open Float Steam Traps. Nos. 235 and 435—Regulating and Reducing Valves.

Stickle

STEAM SPECIALTIES COMPANY

2225 VALLEY AVENUE • INDIANAPOLIS, INDIANA

FOR 40 YEARS REDUCING STEAM COSTS IN PAPER MILLS

Washington, D. C., to discuss ways in which the **bituminous coal industry** can advance use of pulverized coal.

Subjects discussed were: abrasion index for metals in contact with moving coal and coal ash, relation of surface and inherent moisture in coal to its grindability, mechanism of combustion, rate of flame propagation, fundamentals of flow of coal and air in pipes, effect of recirculation of flue gases on combustion, fusion of coal ash, and radiation from flames. To improve firing equipment, more information is needed and a committee will work up a program.

Average days' coal supply held by electric utilities on Feb 1 was 59 days, a drop of two days from the Jan 1 supply. Coal on hand Feb 1 totaled 13,871,000 tons. Electric utilities consumption in January totaled 7,257,000 tons, a decrease of 3.1% from Dec consumption. Daily average consumption by utilities in Jan: 234,097 tons.

Average number of days' supply on Feb 1 by regions was as follows: New England, 79 days, down 23; Middle Atlantic, 52, down 2; Ohio 44, up one; Mich., 91, down 13; Ill.-Ind., 60, down 3; Lower Mo. Valley, 61, up one; Lake Dock T'y, 115, down 11; Southeast, 50, up 10; Southwest, Mountain and Pacific, 62, down 8. Total all regions, 59, down 2.

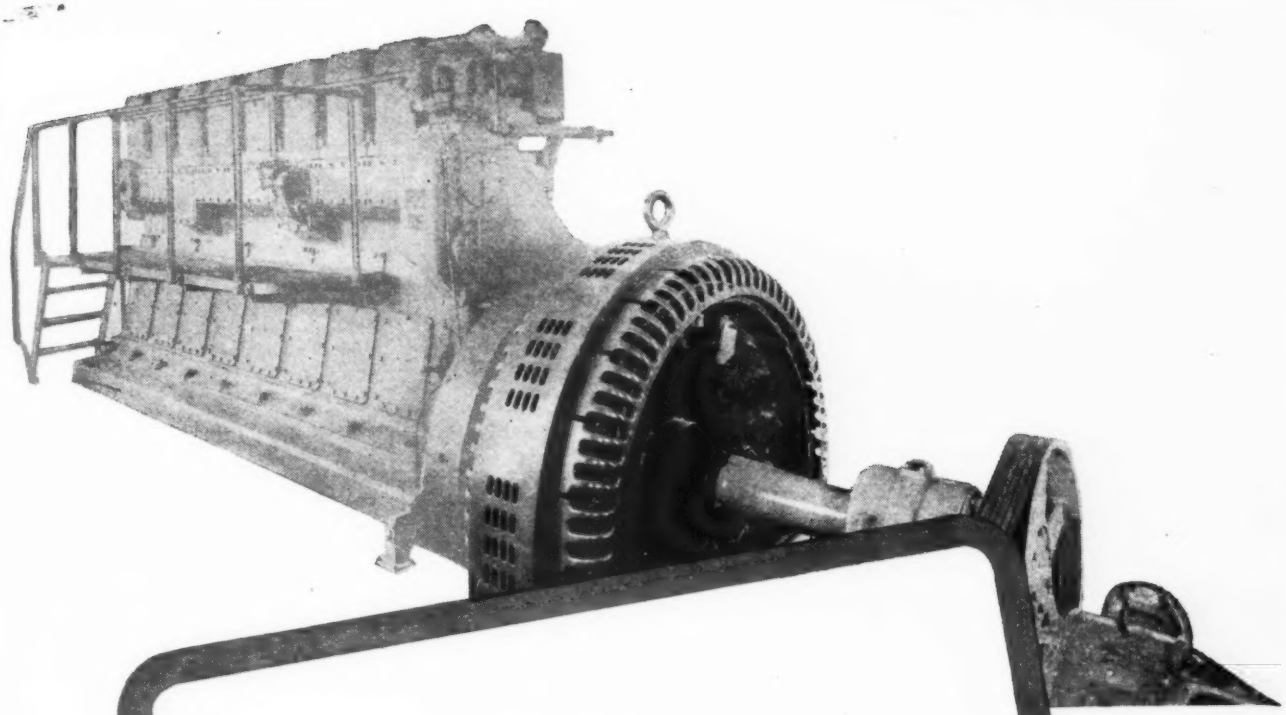
Saving coal, fuel oil, heating gas and other fuels received additional impetus in March when officials of the national fuel efficiency program met in Chicago to plan local campaign procedure. Nearly 40 men, including some of the nation's foremost authorities in fuel utilization indicated they would be at the Chicago conference.

Solid Fuels Adm issued a regulation that shipments of solid fuels hereafter may be made by producers and wholesalers only subject to possible **reconsignment, diversion or rerouting** in transit to meet emergencies. No person shall be subject to damages for contract defaults from such emergency action.

By amending another order, SFA eased the prohibition against shipment of anthracite west of Pa., allowing half the normal amount so shipped to be shipped west during Feb and March to provide fuel for anthracite users unable to use substitutes. The order will allow 40,000 to 50,000 tons to flow west monthly, plus 4000 to 5000 tons to be shipped to Canadian ports.

General Electric has built and tested an electric motor operating at the record-breaking speed of 120,000 rpm, or more than seven million revolutions per hr. They developed the motor for application to internal grinding machines used in finish grinding small holes, many less than ¼ in. in diameter, in vital war parts. Another possible use is in driving small drill chucks for drilling tiny holes in soft metals, using drills 1/32 in. diameter and less.

Faraday Medal, Institution of Electrical Engineers, London has been awarded to Dr. Irving Langmuir, associate director, GE Research Laboratory, for world-wide services to electric science and engineering.



SPECIFY WESTINGHOUSE

...get *undivided responsibility* for the complete electrical installation

Complete Electrical Equipment for Diesel Power Plants

Westinghouse also supplies exciters, voltage regulators, switchboards, circuit breakers, transformers, auxiliary equipment and controls — all coordinated in design for operation as a unit.

Undivided responsibility—Westinghouse assumes full responsibility for providing the *complete* electrical installation . . . speeds negotiation.

Matched performance—Regardless of make of Diesel you purchase, Westinghouse builds the generator with characteristics to match those of the engine . . . assuring stable operation and long life of the unit.

24-hour-a-day service—Provided for all of your electrical equipment from 37 strategically located Westinghouse service shops.

For more information, call nearest Westinghouse office or write for B-3028, "A-C Generators for Diesel Engine Drives." Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Dept. 7-N.

J-10265j

Westinghouse PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

A-C GENERATORS FOR DIESEL ENGINE DRIVES

For Old Darts . . . to be used again!

Any time spent in locating old Dart Unions around your plant buildings and yards is *well worth while* . . . for, Darts are made to be used over and over again, giving tight joint, economical performance each time. (And, when you re-use your Darts, you are conserving the Nation's metal supply.)

There are good and sufficient reasons why Dart Unions can be used so many times with such satisfactory results. And these reasons are worth remembering. *Darts have matched bronze seats, ground to accurate "true-ball" surfaces* . . . Darts bodies and nuts are made of air refined malleable iron that resists pipe strains, rough handling, rust.

Even if you have already made several searches for your old Darts, authorize *another* one. And see your supplier if you need new ones.

DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

CURRENT AWARDS

Army-Navy E pennants now fly over: U. S. Motors Corp, Apr 7, The Cooper-Bessemer Corp, Mar 7.

White stars (Army-Navy E renewals) to: Warren Steam Pump Co, Inc, 1 star, The Bristol Co, 1 star; Buffalo Pumps, Inc, 3 stars.

Gold star, Maritime M pennant: Trill Indicator Co, Feb 25, 2 stars.

Double Award (E and M pennants) to: Jenkins Bros, third award by U. S., Maritime Commission and fourth award by Army-Navy.

National Security Award (OCD) to: Cincinnati Gas and Electric Co; West Penn Power Co; Westinghouse Elec & Mfg Co's Nuttall Works, their Essington, Pa. plant, and small motor div, Lima, O.; Anaconda Wire and Cable Co's five establishments; Kennecott Copper Co; Wagner Electric Co.

Distinctive Guidon for exceptional plant protection to U. S. Machine Corp.

Am Society of Refrigerating Engr will meet in Pittsburgh, June 5-7. Current development in design and application of equipment will be emphasized. Authorities will present papers on frost zone psychrometry, hydrocarbon refrigerants, cold cathode lighting for refrigerated spaces and effect of unstable flow on rapid temperature changes in confined spaces, refrigeration in synthetic ammonia production, etc.

Council of ASRE has approved the petition of a group of members in the San Francisco area to form a local section, the 16th recognized local group of the 39-year-old society.

A pocket-sized bimonthly, "Allis-Chalmers Operation and Maintenance Review" succeeds "Victory Production and Maintenance News." It contains maintenance tips from A-C engineers and articles on current trends for shopman and executive. Equipment users are invited to exchange operation and maintenance ideas.

Power production in 30 Bureau of Reclamation power plants in 1943 soared to a record high of 11.9 billion kwhr—275% increase since Pearl Harbor. Grand Coulee has set an all-time world's record for production in one month, Jan, 1944, of 604,444,000 kwhr.

Installed kilowatt-capacity at all Bureau plants totaled over 2,000,000 kw, at the end of 1943, and projects cleared for completion in 1944 will bring into production about 340,000 kw additional capacity. Other installations, which could be made within the next two years, except for wartime limitations, total around 800,000 kw, which would bring 1945 total to more than 3,200,000 kw.

Iron Fireman Mfg Co's main plant in Portland, Ore., makes the main drive shaft and numerous other parts of the Water Buffalo, an amphibian tank. It also supplies parts for Flying Fortresses and other aircraft and makes high-priority stokers. A recent $2,500,000 fire partly destroyed another Iron Fireman Portland plant.

Reduce Power Interruptions with Timken Bearing Equipped Pillow Blocks

As long as there is power, you can depend on modern transmission units—pillow blocks and line shaft hangers—equipped with Timken Tapered Roller Bearings to keep it flowing steadily from source to application points.

Power interruptions due to transmission equipment inadequacy are eliminated along with power wastage, lubrication difficulties and excessive maintenance expense. Shafts last longer because they are protected against wear and whip.

It is of particular importance to the chemical and processing industries that Timken Bearings can be so effectively sealed that destructive fluids and abrasive materials are kept out of the bearings, which accordingly means longer life. The same closures that prevent foreign matter from getting in, stop lubricant from leaking out and thereby contaminating the product.

Is your power transmission system involving you in unnecessarily high costs? It will pay you to check up now and to replace wasteful units wherever they are found. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Dodge-Timken Double Interlock Pillow Block manufactured by the Dodge Mfg. Corporation, Mishawaka, Indiana.

20 to 500 H.P..... to 200 lb. pressure

Here is a steam-generating unit that may help you in meeting the new conditions under which we may all have to work when the shooting war is over and the war on costs begins in earnest. You should know more about this unit.

It is a complete unit, with all necessary component and auxiliary equipment, ready to connect and operate. It is amazingly efficient, requires no stack, arranged for full or semi-automatic operation, and is compact yet fully accessible for adjustments and maintenance. It has a number of ingenious and interesting features described in a folder which you may have without obligation.

The "Dividends" booklet is helping to make better jobs for hundreds of operating engineers. It tells, without advertising any product, what a company manager ought to know about the power plant. Get a copy for the executive heads of your company and watch their respect for you and your job grow. It's free.

Preferred Utilities Manufacturing Corporation 1860 BROADWAY, NEW YORK 23, N. Y.
Please send, without obligation the bulletins checked.

☐ UNIT STEAM GENERATOR
☐ DIVIDENDS FROM YOUR POWER PLANT

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P-5-44

PREFERRED UTILITIES
MANUFACTURING CORPORATION

Canada's 1943 Hydroelectric Progress

According to T A Crerar, Minister of Mines and Resources, Canada added 1,002,273 hp of water power in 1943 to meet the maximum estimated demand for munitions production and civilian use. Because this total includes capacity of three units transferred to newer stations and certain other adjustments, it must be reduced to a net increase for the year of 810,973 hp, bringing Canada's total hydraulic development to 10,034,513 in Jan, 1944. Great as this installation is, it leaves more than 80% of Canada's water-power resources for development as demand arises.

More than 90% of hydraulic development is installed in central stations distributing electricity to the public, and these stations generate more than 98% of all electricity sold in Canada or exported to the U. S. Total output for 1943 exceeded 40 billions kwhr.

Year's outstanding development was completion of the great Shipsaw generating station of the Aluminum Power Co on the Saguenay River, Quebec.

APPOINTMENTS

The Reliance Electric & Engrg Co has transferred **C B Allen** from Washington to the Detroit district as application engineer. **Kieley & Mueller, Inc** has appointed **Albert J Lilygren** sales representative for Oregon and Washington. **Bailey Meter Co** appoints **N M Barnett** manager of its Chicago office. The vacancy in Detroit created by his transfer will be filled by **Ralph T Cowan. H C Allington** has been appointed sales research engineer by **Wickwire Spencer Steel Co,** with particular emphasis on the oil and petroleum fields. **U. S. Rubber Co** has appointed **W S Long** Pacific Coast sales manager, mechanical goods. **J M Miller** continues as factory manager of the Los Angeles plant. **The Frick Co** has appointed **W J Dugas** manager of the Md.-Va.-D. C. territory with headquarters in Washington.

Elastic Stop Nut Corp has made **Harry K Werst** vice-president in charge of manufacturing. **R W Owens** is appointed assistant to the president, **Elliott Co. Hanlon-Waters, Inc,** announce that **Edw F Deacon, Owen L Coon** and **James E Allison** were elected to the board of directors at the annual meeting. **Goodyear Tire & Rubber Co** announce that **L K Hansen** will manage **pliofilm's** foreign representation and that **Frank T Magennis** has been named vice-president of the export company. **American Locomotive Co** have appointed **C D Williams** vice-president and general counsel of corporate and legal affairs, and **Carl A Sundberg** has been made secretary; **Henry Schreck** has been appointed consulting engineer of the diesel engine div.

David M Hadlow is now mgr of the Hartford office, **Hartford Steam Boiler Inspection & Insurance Co,** succeeding **F H Kenyon . . . R L Lewis** join-

No Limit!

Possibilities for the profitable application of electric motor-drive to production processes of many kinds today are almost without limit. Reliance engineering experience has proved that electric motors, instead of being merely convenient and economical sources of power, can be made to do many things which formerly called for complicated mechanical hook-ups and controls. Moreover, they are doing the work better, more economically and with improvement in the quality of the finished product.

Some of the results that Reliance engineers have helped to accomplish in applying electric motor-drive are likely to suggest interesting new possibilities to you. We will be glad to tell you about them.

RELIANCE ELECTRIC & ENGINEERING CO.

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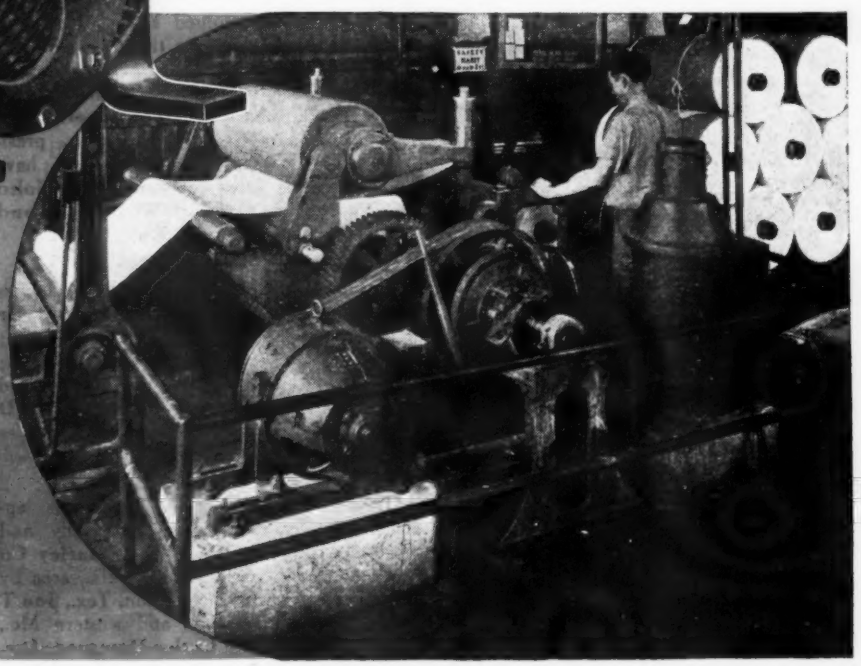
Birmingham • Boston • Buffalo • Chicago • Cincinnati • Detroit
Greenville (S. C.) • Houston • Los Angeles • Minneapolis • New York
Philadelphia • Pittsburgh • Portland (Ore.) • St. Louis • Salt Lake City
San Francisco • Syracuse • Washington, D. C. • other principal cities

RELIANCE A-C D-C MOTORS



There are no longer any limitations to the ready use of wide-range adjustable-speed drives in plants having only a-c power. • Reliance V★S Drive can be connected to the same power lines as your a-c squirrel-cage motors. • Used on this padding machine in a textile mill, it provides speeds for threading at from 10 yards a minute up to 120 yards a minute—a 12:1 ratio. Still wider ranges are available. • For details, write for Reliance Bulletin 511.

Maintenance and Servicing of Electrical Instruments

By

JAMES SPENCER

In charge of Instrument and Relay Department, Meter Division, Westinghouse Electric & Manufacturing Co., Newark, N. J.

•

REPRINTS AVAILABLE

This reprint should be of great value to all those whose problem it is to keep in operation the electrical instruments on vital war production as well as those on planes, signal equipment, tanks, ships, guns and other armament.

The electrical instrument industry has expanded more than 30 times its normal production, but its service facilities in general have not kept up with this pace. Some electrical instrument manufacturers do practically no servicing and cannot promise early return of the few instruments they accept for repairs.

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Economy Equipment Co, and will operate both in St. Louis and Kansas City territories . . . **Wm W Small** has joined the **Power Specialty Co** as application and service engineer . . . **Wm O Wilson** has been appointed commercial vice-pres of **Worthington Pump & Machinery Corp** with headquarters in Chicago . . . **Pyrene Mfg Co** announces these promotions: **Nelson Bauer** becomes asst genl sales mgr; **Raymond F Poole,** district mgr in Newark, N. J.; **Frank R Kachel,** asst district mgr in Chicago; **Truman Young,** adv mgr.

SKF Industries, Inc announce that **Walter C Ahlers** is Detroit district mgr . . . **G Bronson Philhower** will represent **Tube Turns, Inc,** in the New York area and New England . . . **Alton P Hall** has been made asst genl mgr of sales, **American Chain & Cable Co, Inc.**

A H Freeman has joined **R L Orth,** representing **Am Foundry Equipment Co** in Detroit . . . **Lyman D Warner** is appointed sales mgr and asst vice-pres, **Crocker-Wheeler div,** Joshua Hendy Iron Works . . . **Robt A Campbell** becomes sales mgr of steel tube div, **Talon, Inc.**

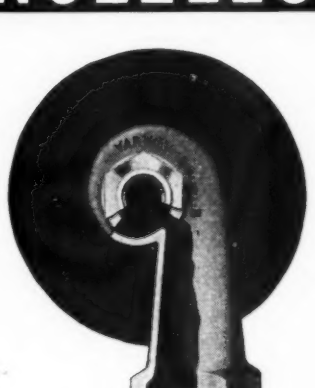
Builders-Providence, Inc has elected Geo W Kelsey to the Board of Directors. This company and its affiliate, **Omega Machine Co,** announce that these three companies will represent them: **W D Taulman & Associates, Evans L Shuff** and **John R Purser Sales Engrs, Inc** . . . **Harnischfeger Corp** announces that **E W Potratz** is mgr, P&H hoist and trav-lift crane sales div and that **J D Glatz** is mgr, repair sales div . . . **General Controls Co** has opened an Atlanta, Ga., office with **Roger W Allen** as mgr.

Independent Pneumatic Tool Co elected **Neil C Hurley,** chairman of the directors and **Neil C Hurley, Jr,** president . . . **The Carborundum Co** has appointed **Chas W Sprenger** district mgr, metropolitan New York district . . . **R P Exten** has joined **Young Radiator Co** as executive asst to the president . . . **The Cleveland Pneumatic Tool Co** and its subsidiary, Cleveland Pneumatic Aerol, Inc, has elected **Daniel C Green** board chairman and **Geo P Torrence,** president . . . **Kieley & Mueller, Inc,** have appointed as sales representatives: **John C Paster** in Fla. and **W E Marmaud** in Detroit and part of Mich.

Westinghouse Elec & Mfg Co makes these appointments: **Wm W Sproul, Jr** is mgr, application dept, Sharon Works; **Russell E Ebersole,** sales mgr, lamp div; **Russell L Whitney,** mgr, agency and specialties div, central district; **Wm D Turnbull,** mgr, agency and specialties dept.

Macmillan Petroleum Corp has appointed **Howard W Cheney** adv and sales promotion mgr . . . **The Marley Co** is represented in the Tulsa, Okla., area by **Walter S Smith;** in Houston, Tex., **Joe T McKinley;** in Kansas and western Mo., **R H Ahrens** . . . **Cutler-Hammer, Inc,**

YARWAY
INVOLUTE
SPRAY
NOZZLES



Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from ¼ in. to 2½ in. Write for Catalog N-616.

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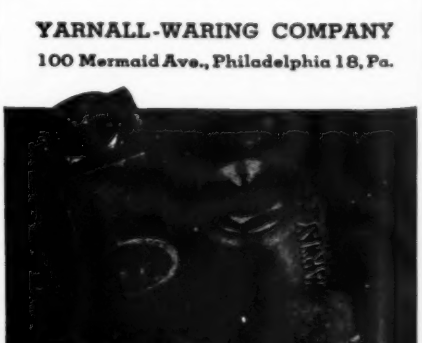
100 Mermaid Ave., Philadelphia 18, Pa.

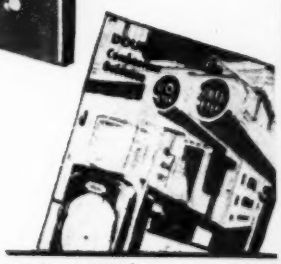


A N N O U N C I N G

A New and Advanced

BOILER RATIO METER *by* COCHRANE

THE Cochrane Corporation offers to the power plant field a new boiler meter of the steam-flow, air-flow type known as the Cochrane Boiler Ratio Meter. This meter has several important advantages over other constructions. An easily adjustable cam in the air flow mechanism permits the operator to establish the relation of air supply to fuel supply (measured by steam generated) most favorable for his particular operation. In addition, a red indication pointer operating across a white 10" scale makes it unnecessary to examine closely the position of the pens to determine whether the air is excessive or insufficient, for the movement of the pointer is 3 times as great as the difference between the pens. The steam flow mechanism is the well-known Cochrane Friction-Free Electric Flow Meter, operating on the null balance principle assuring highest accuracy, while the air flow mechanism is based on the highly responsive Hays slack diaphragm, equipped with an electric motor follow-up for ample power. Intelligent use of the Cochrane Boiler Ratio Meter will result in lower operation and maintenance costs as well as greater plant capacity without increasing the size of the steam producing units or auxiliaries.



Write NOW for a copy of Publication 4071, "Double-Barreled Combustion Guidance" giving important facts about the use of boiler meters in increasing the efficiency and lowering the costs of power plant operation.

COCHRANE CORPORATION — 3106 N. 17th Street • PHILADELPHIA 32, PA.

THE MOST COMPLETE LINE OF FLOW MEASURING INSTRUMENTS

It says

"STOP" to Solids—

"GO" to Fluids

A BETTER Strainer to "police your pipelines"

- **FIRST**—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.
- **SECOND**—*Finish*. Cadmium plated inside and out for protection against corrosion.
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- THOUSANDS IN SERVICE—Sold by over 100 Mill Supply Houses.

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-200.

YARNALL-WARING COMPANY
100 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

names **G E Hunt** acting mgr of the Atlanta territory . . . **Corliss A Bercaw** is asst genl mgr of **Elliott Co's** Springfield, O., div . . . **Stearns Magnetic Mfg Co** names **Stanley L Burgess** sales representative in the Detroit territory . . . **American Chain & Cable Co, Inc,** and Associate Companies, appoint **Edw V Creagh** adv and sales promotion mgr.

Bridgeport Brass Co has made **Mead W Batchelor** a vice-president and **A Dean Merwin,** asst secy . . . **Plibrico Jointless Firebrick Co** has appointed **Nevil C Withrow** distributor in the Little Rock, Ark., district . . . **Roland B Bourne** is vice-president in charge of research and **Frank L Orr** is vice-president in charge of sales for the **Maxim Silencer Co** . . . **Wickwire Spencer Steel Co** elects **R T Dunlap** and **E F Early** vice-presidents, and appoints **Harry E Roulfs** labor relations mgr . . . **Martin N Gozdenovich** is representing **The General Blower Co** (The American Coal Burner Co) in the Eastern district . . . **Carroll M Snyder** has joined the **C-O-Two Fire Equipment Co** as asst to the president.

An AIEE paper, "A Magnetic Type Air Circuit Breaker for 15,000-Volt Services," by L J Linde and B W Wyman, General Electric, describes the development of a "Magne-blast" circuit breaker for 15-kv services with an interrupting rating of 250,000 kva as an extension of the principle used in developing the 5-kv Magne-blast breaker.

OBITUARIES

Frederick W Goetze, 52, pres of The Goetze Gasket & Packing Co, died of a heart attack on Jan 30.

Jas L Goodwin, pres of The Whitlock Mfg Co, died Jan 28. He had been in ill health for some time.

Wm H Laverack, 64, pres and treas of the Dampney Co of America, died March 10.

Matthew O Troy, a commercial vice-pres of General Electric Co, died suddenly on Mar 13, at the age of 71.

Chas E Atkins, 73, retired chief engineer, Wheelwright Paper Co, died recently.

Francis K Kernan, pres of The Bossert Co, Inc, died March 11.

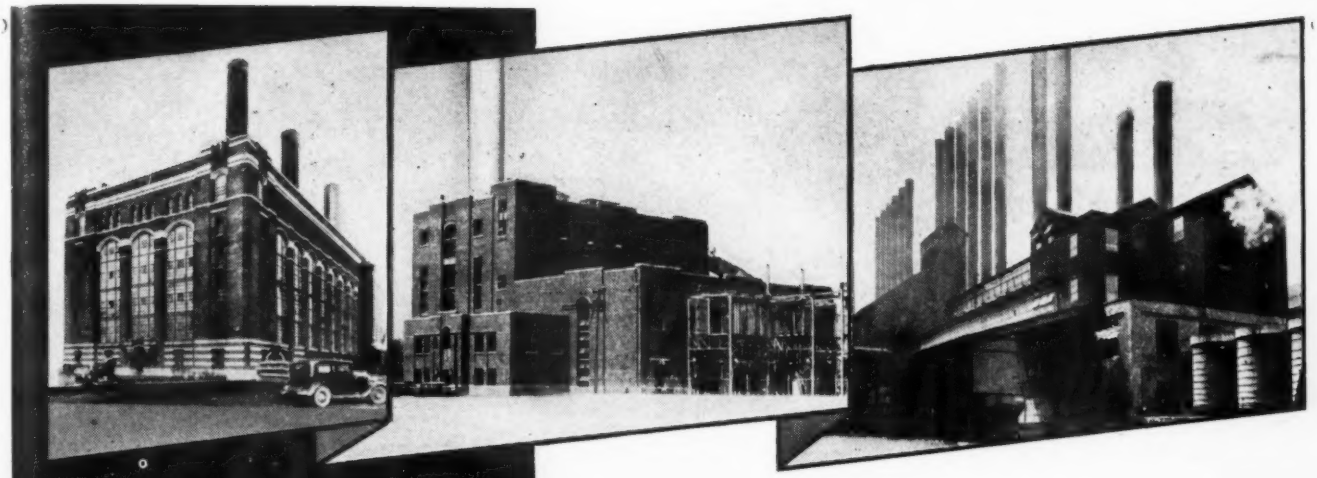
Harry A Hagerman, 66, retired chief designing engineer for TVA, died March 23.

Calvin L Day, 57, of Robins Conveyors, Inc, died on Mar 13, following a short illness.

Albert B Williams, 59, consulting engineer, Stone & Webster Engrg Corp, until his retirement Feb 29 from ill health, died on March 29.

Edmund D Monk, consultant on power transformer sales for General Electric, died suddenly on March 16.

James S Nicoll, 52, vice-pres of Kelly O'Leary Steel Works, died following an illness of several months.

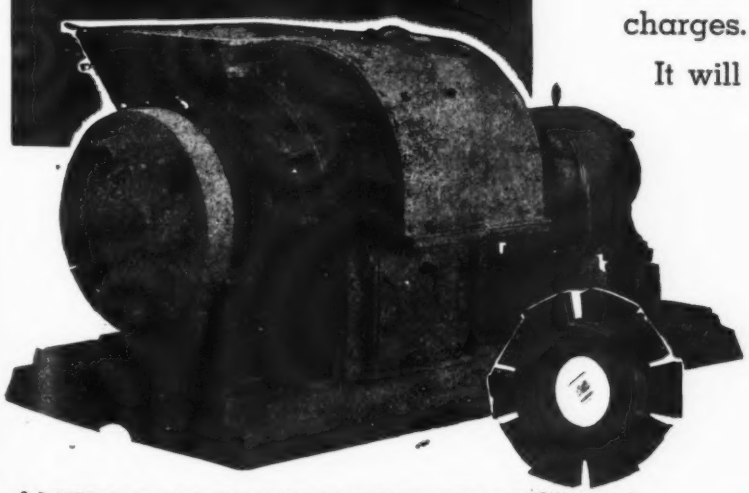


You may not know what coal you're going to get . . . but YOU CAN BE ASSURED OF PROPER SIZING with AMERICAN RING CRUSHERS

The importance of a method of preparing coal which has proved effective on *all* coals is greater today than ever. This fact is emphasized by an impredictable future coal situation which involves the quality of coal you are likely to get.

The "AMERICAN" way has proved the right way to size coal regardless of the kind of coal or the operating conditions involved. In the plants shown here, "AMERICANS" prepare a variety of different coals exactly as required to obtain maximum combustion efficiency. And because in every case the "AMERICAN" way has proved economical as well as effective, it offers *you* an assured means of achieving proper coal sizing regardless of the quality of the coal delivered into your bunkers. Experience shows that the cost of crushing will not exceed a cent a ton for *all* operating and fixed charges.

It will pay you to investigate—NOW!



THIS "AMERICAN" FEATURE MEANS BETTER COAL PREPARATION

Proper sizing—regardless of coal quality or whether for stoker or pulverized fuel firing—is attained in the "AMERICAN" by this reversible manganese steel shredder ring. This ring splits the coal instead of crushing it. Exact sizing is easily controlled to meet specific operating needs.

AMERICAN PULVERIZER COMPANY 1349 Macklind Avenue, St. Louis 10, Missouri

ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

With American Industry, the March of Time has become a gallop. And in the power field there is an ever-growing demand for flow control equipment to handle higher and higher pressures and temperatures.

As in every other branch of industry, POWELL Engineering has not only kept in step but has actually anticipated each new development. The result is POWELL'S complete line of Cast Steel Valves that "will do the job" because *POWELL performance is pre-determined.*

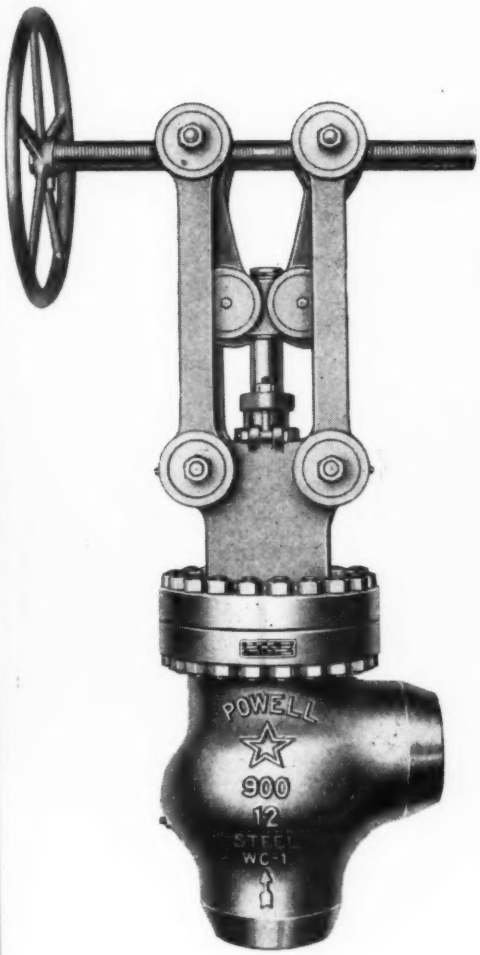
So don't risk valve failures by installing valves that may not have been designed to meet your individual requirements. Consult POWELL Engineering *first.*

POWELL

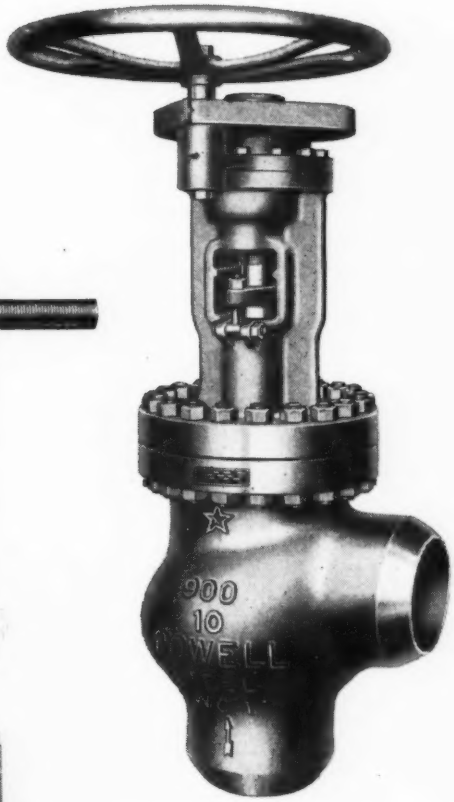
The Wm. Powell Company

Dependable Valves Since 1846

Cincinnati 22, Ohio



Class 900-pound, 12-inch, Cast Steel Non-return Angle Valve, with welding ends. Toggle operated. Powell Non-return Globe and Angle Valves are scientifically designed and engineered, with streamline bodies that provide maximum flow area with minimum pressure drop.



Class 900-pound, 10-inch, Cast Steel Non-return Angle Valve, with welding ends. Spur gear operated. Powell Non-return Globe and Angle Valves can be supplied in various sizes and for all pressure classes from 300-pounds to 2500-pounds, inclusive.

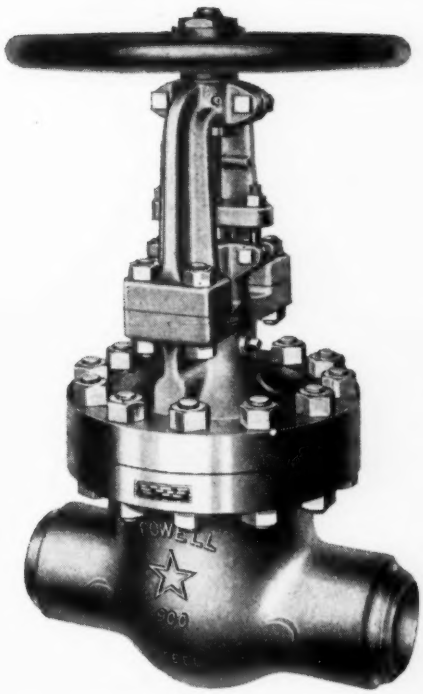


Fig. 9003 W. E.—Class 900-pound Cast Steel Gate Valve, with welding ends, outside screw rising stem, bolted flanged bonnet and taper wedge solid disc. One of the complete line of Powell Cast Steel Valves designed to meet the flow control requirements of the modern Power Plant.

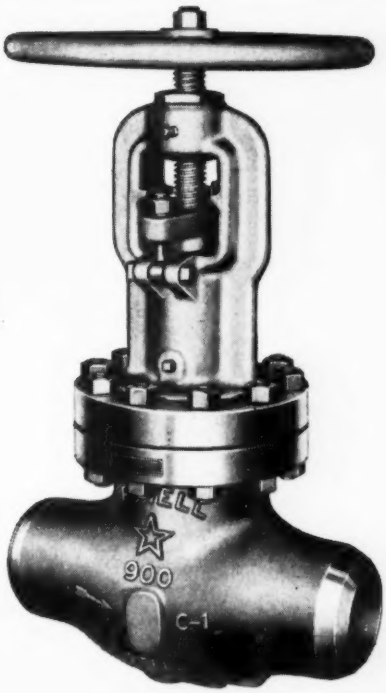
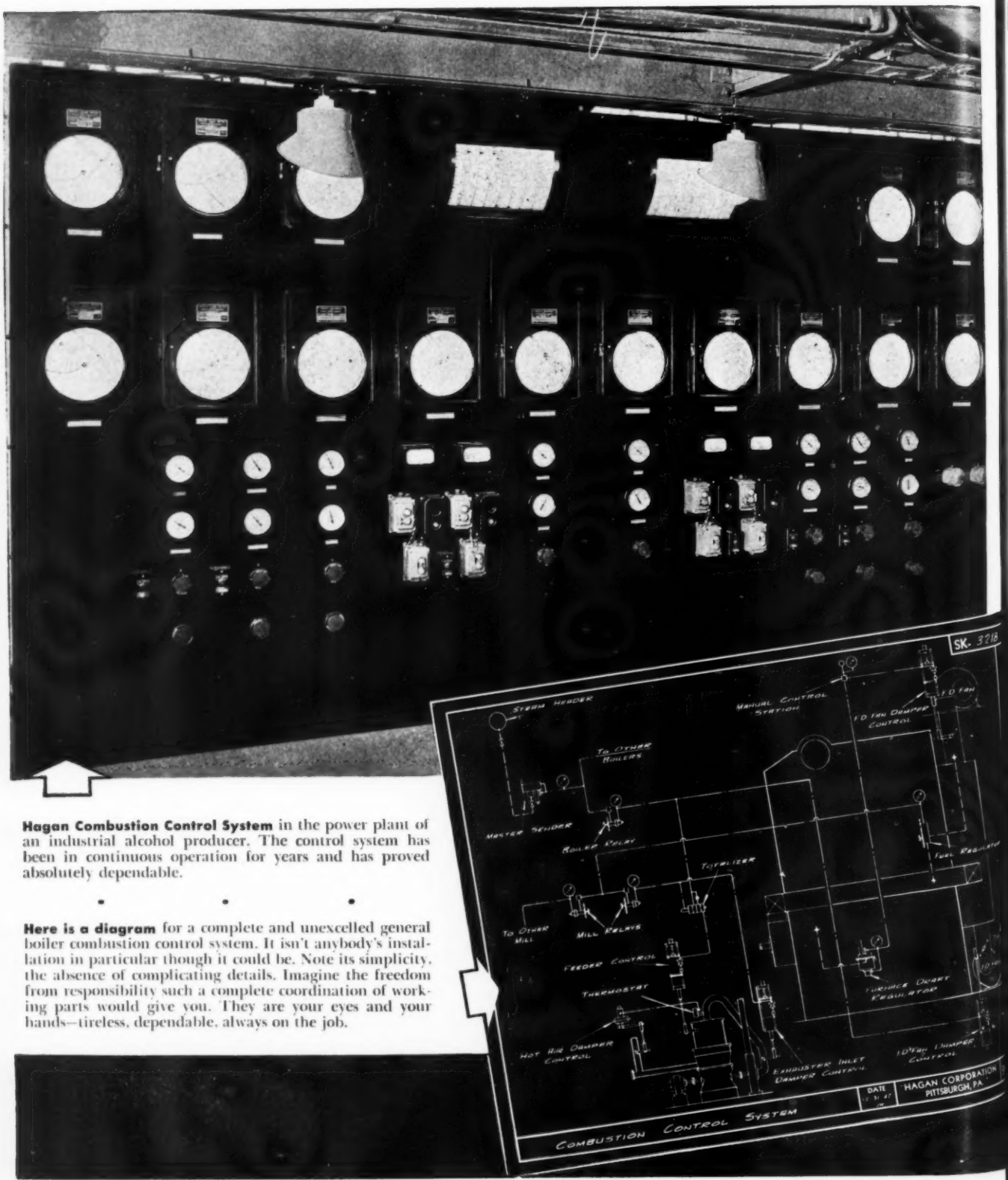


Fig. 9031 W. E.—Class 900-pound Cast Steel Globe Valve, with welding ends, outside screw rising stem, and bolted flanged bonnet. Powell Cast Steel Valves—Globes, Angles, Gates and Checks—are available in a wide range of sizes, for all pressure classes from 150-pounds to 2500-pounds, incl.

VALVES

Write your own



Hagan Combustion Control System in the power plant of an industrial alcohol producer. The control system has been in continuous operation for years and has proved absolutely dependable.

• • •

Here is a diagram for a complete and unexcelled general boiler combustion control system. It isn't anybody's installation in particular though it could be. Note its simplicity, the absence of complicating details. Imagine the freedom from responsibility such a complete coordination of working parts would give you. They are your eyes and your hands—tireless, dependable, always on the job.

Specifications

FOR COMBUSTION CONTROL

. . . and see how closely they are met by Hagan!

SUPPOSE you were to put down on paper your own conception of what an ideal system of Automatic Combustion Control should offer. It would look something like this.

1. It should be simple and foolproof. Hagan Control operates on a simple pneumatic system. The slightest or the most sudden change in steam pressure starts a chain of operations which quickly restores steam pressure to normal. This is all automatic and foolproof. No operator needs to watch instruments or make adjustments.

2. It should be absolutely dependable. Hagan Control is as carefully engineered as any machine. It does not depend on fragile instruments for its operation. Some of the first units of Hagan Control installed 25 years ago are still in daily service.

3. It should be accurate and flexible. Hagan Control is designed to operate accurately and quickly without "hunting." It is flexible in operation so that it can be used for any type of fuel with equally good results.

4. It should be economical with fuel. Fuel savings up to 10% are not unusual with Hagan Control. There are many cases where higher savings have been made. The general use of automatic combustion control in power plants has been a major factor in relieving fuel shortages in this war.

5. It should give uninterrupted service. Hagan Control is designed to stay in continuous operation in hot, dirty locations. It is built ruggedly and requires little maintenance or adjustment.

Find out about Hagan Control. It is used not only for boilers, but is also applied to all types of industrial furnaces, steel mills, and chemical processes.

HAGAN CONTROL ASSURES

MAXIMUM quantity of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM utilization value of steam, uniform steam pressure and temperature.

MAXIMUM output from boilers of differing capacities, automatically.

MAXIMUM steam for production, by reducing loss of steam in frequent soot blowing.

MAXIMUM protection of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN
HALL
BUROMIN
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HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

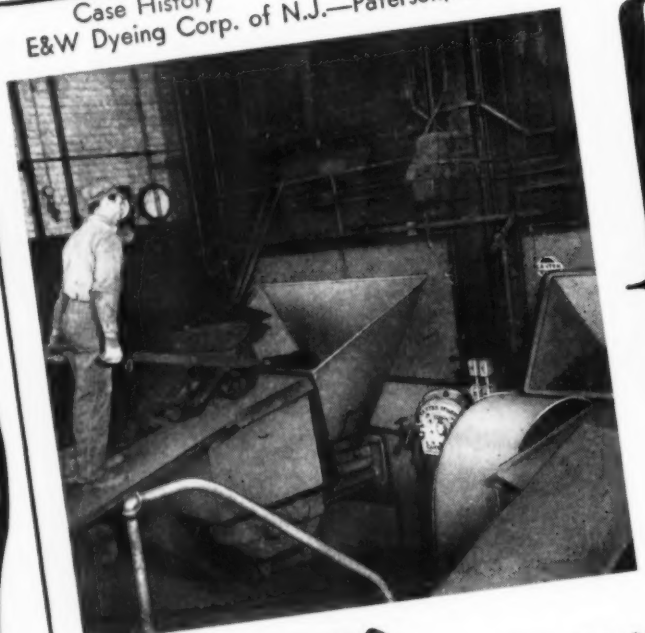
Two more examples of
CANTON'S *typical* SERVICE

Saving FUEL, MANPOWER AND MONEY
Stepping up EFFICIENCY AND STEAM OUTPUT

On the industrial front Canton Stokers are giving unfailing service — keeping vital power plants producing at "top" output. That's one reason why hundreds of organizations rely on Cantons — know their economy of maintenance and operation, praise their rugged durability to withstand gruelling service without let-down.

Because Canton Stokers are engineered for the toughest assignments, you can readily understand why Canton's files are filled with many case history success reports. Also why so many Canton users are repeat buyers when additional boilers need dependable stoker equipment. Worth investigating for your needs, too? Send the coupon today.

Case History
E&W Dyeing Corp. of N.J.—Paterson, N.J.



OVER 200% OF RATING EASILY— AFTER CHANGING FROM OIL TO COAL WITH CANTONS . . .

A large volume of steam is required at The E. & W. Dyeing Corporation for their processing and heating operations. With increasing demand upon the two 250 H.P. boilers formerly oil fired, the change-over to coal firing with Cantons made possible efficient operation at 200% of rating and easily met the higher demand for steam. Mr. R. Ullnick, Purchasing Agent for E. & W., reports "completely satisfactory service from the two Vulcan Ramfeed Cantons with no repairs necessary since installation." Yes, another example of Canton's dependable service and worthwhile savings.

THE ONLY STOKER
Guaranteed
5 YEARS AGAINST
DEFECTS AND WEAR

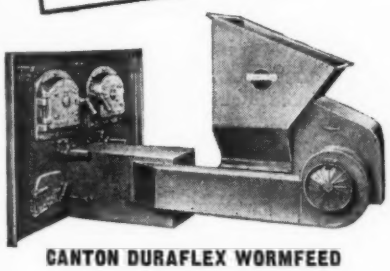
CANTON
STOKERS

CANTON STOKERS

Case History
Newburgh & South Shore Railway, Cleveland, O.

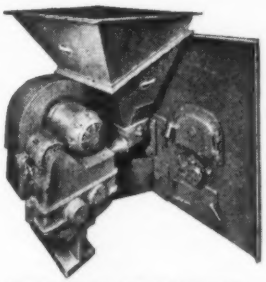
CANTON STOKER EFFICIENCY ENABLED ONE BOILER TO HANDLE FULL LOAD

Over three years ago a Canton LO-SET Ramfeed Stoker replaced another make Ramfeed Stoker under the smaller of two boilers at the Newburgh & South Shore Railway, Cleveland, Ohio, boiler house. Because of the Canton unit's ability to efficiently fire this boiler at over ratings, the entire load was easily maintained with the one boiler. When demand was further increased the second boiler's stoker equipment was removed and replaced by another Canton LO-SET Stoker which raised the total steam output to maximum. Again outstanding success with a Canton stoker led to repeat business—typical of Canton's performance everywhere.



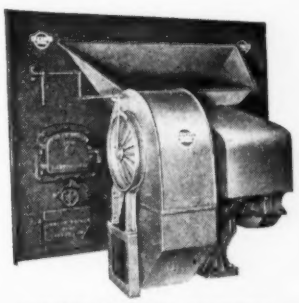
CANTON DURAFLEX WORMFEED

A side dump stoker — front fan mounting—zoned air control—especially adaptable to converting existing boilers to stoker firing.



CANTON UNIFLEX RAMFEED

Compact arrangement—front motor mounting, separate fan drive—engineered for limited space installations.



CANTON VULCAN RAMFEED

Ruggedly constructed and engineered for heaviest loads — also available in LO-SET models. Famous for carrying high overload capacities.

54 TYPES AND SIZES FOR EACH NEED UP TO 800 H.P.

Canton Ramfeed and Wormfeed Stokers are literally engineered for each specific job. You can be certain after thorough analysis of your need, that the Canton model selected will meet all requirements.

SEND TODAY FOR DESCRIPTIVE LITERATURE AND COST SAVINGS FACTS

CANTON STOKER CORPORATION

741 ANDREW PLACE, S. W., CANTON, OHIO

Gentlemen:

---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediately

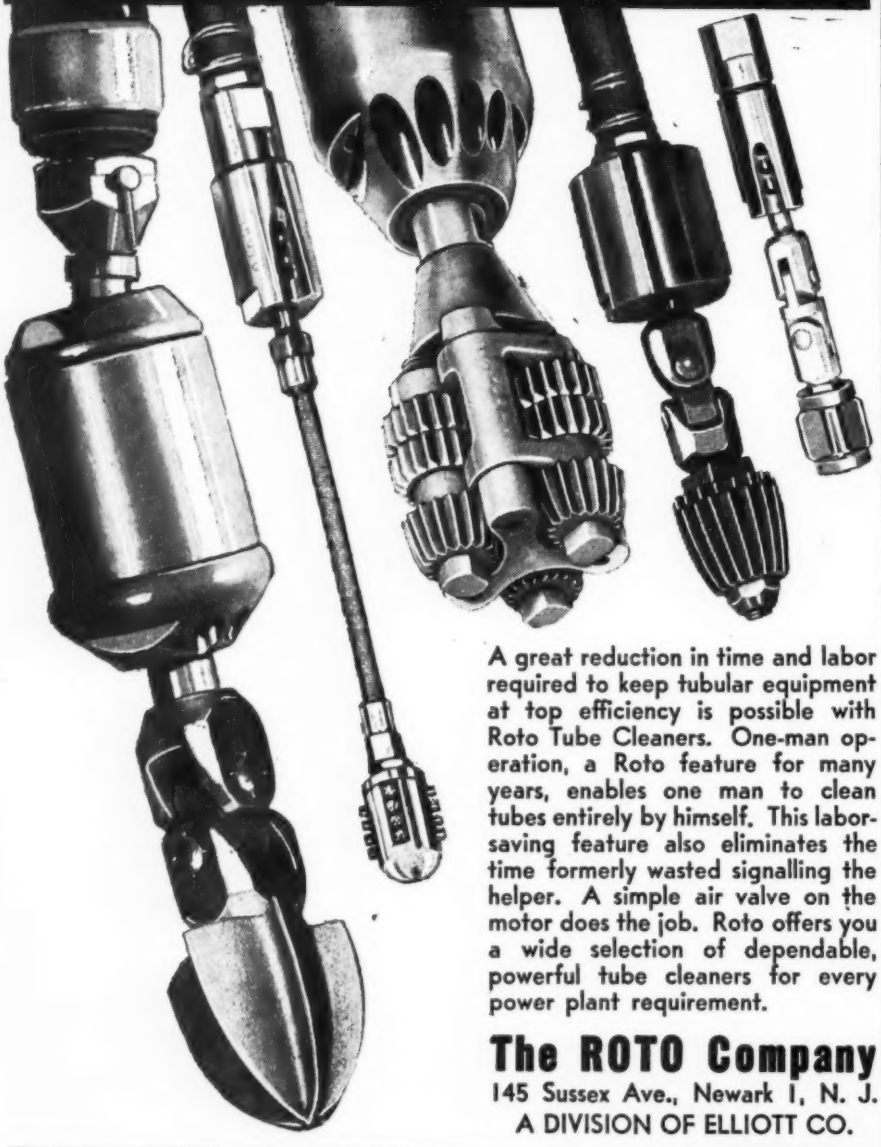
Name _____

Company _____

Address _____

City _____ State _____

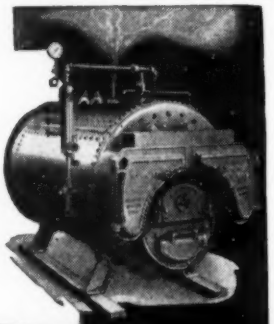
ROTO Tube Cleaners
help you to operate efficiently WITH REDUCED MANPOWER



A great reduction in time and labor required to keep tubular equipment at top efficiency is possible with Roto Tube Cleaners. One-man operation, a Roto feature for many years, enables one man to clean tubes entirely by himself. This labor-saving feature also eliminates the time formerly wasted signalling the helper. A simple air valve on the motor does the job. Roto offers you a wide selection of dependable, powerful tube cleaners for every power plant requirement.

The ROTO Company
145 Sussex Ave., Newark 1, N. J.
A DIVISION OF ELLIOTT CO.

KEWANEE
SCOTTIE JR BOILER



5 sizes for small industrial usage. 9.9 to 30 H.P. Conveniently compact, yet easily accessible. Low in cost—economical to operate.

75 Years Boilermakers

For 6" scale with pipe diameter marking, write Department 99-K5.

KEWANEE BOILER CORPORATION Kewanee, Illinois

High Pressure Steam at Low Cost

Division of American Radiator & Standard Sanitary Corporation

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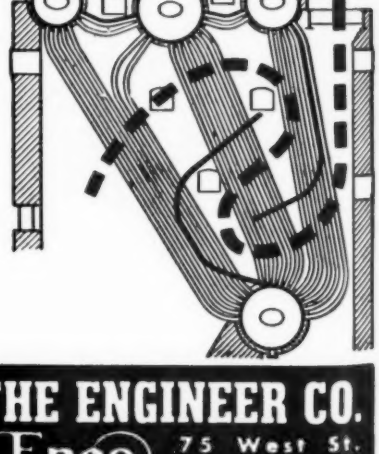
Enco

Extra Power Quickly
...and easily... with these Fuel-Saving Baffles

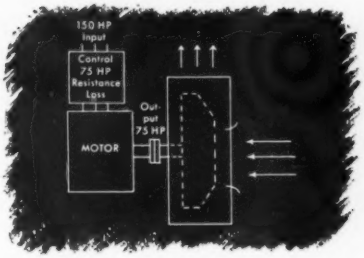
- Provide cross-flow of gases over tubes for maximum heat-transfer
- Tapered gas passes and curved surfaces streamline the gas flow and maintain gas velocity for efficient heat-extraction
- Draft losses materially reduced by elimination of eddy currents, bottlenecks and dead gas pockets
- Less steam used in cleaning because soot blowers are used less often, and more effectively
- Applicable to any design of water-tube boiler, fired by any fuel
- Each installation is designed on the basis of 25 years experience in this specialized branch of engineering
- Installed by skilled mechanics

Ask for bulletin BW 40 giving valuable data on modern baffle-wall constructions — free



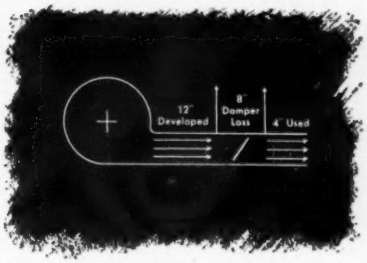
THE ENGINEER CO.
Enco 75 West St. New York, N. Y.

VARIABLE SPEED MOTOR CONTROL



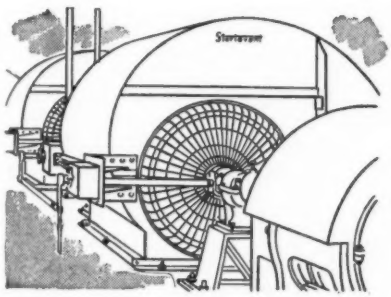
In considering a variable speed motor to drive your mechanical draft fans, remember you can develop a *limited* selection of pressure-volume characteristics to meet combustion requirements. The headaches start when, as frequently occurs, fan output *between* the motor step-speeds is desired. Another drawback is the expensive and extensive auxiliary equipment involved. And finally, when an a.c. variable speed motor operates at reduced speeds, its efficiency drops off rapidly.

DAMPER CONTROL



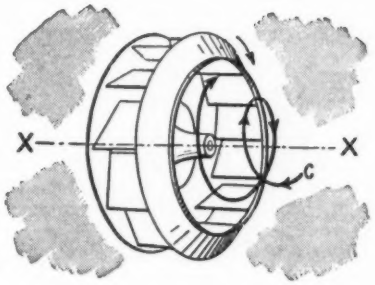
Placed in the system served by a fan as shown above, the damper throttles the flow of air delivered—and may be regulated to any point. But here's where inefficiency begins: A constant speed a.c. motor drives the fan at top speed at all times. Terrific pressure wastage is inevitable, and this waste is directly reflected in power costs. It is like a bearing without oil.

This is Sturtevant *Vane Control*



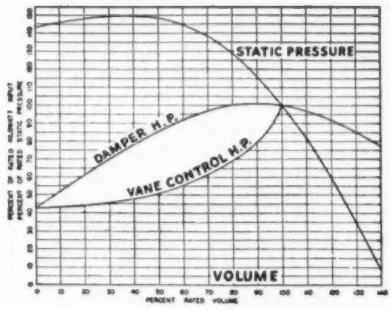
...All "Plus" Advantages!

Sturtevant Vane Control offers the major advantage of utilizing a constant speed a.c. motor with simple control and in addition permits regulation of the fan output to the exact volume of flow at the *exact* pressure needed. There is no wastage of power input as in a variable speed a.c. motor. There is no wastage of pressure as encountered in damper control. There is *more even* distribution of gases and ash to the fan wheel blades—prolonging life.



...instant response!

The adjustable vanes of Sturtevant Vane Control at the fan inlet can be set to give the entering air or gas a greater or lesser spin in the direction of rotation of the fan rotor. As the vanes open and close, the "twist" imparted to the air entering the rotor is de- or accelerated, correspondingly affecting the pressure-volume of the fan output *without* need for change in the speed of the fan or the motor. Vane Control permits *instantaneous* adjustment of air flow to meet the fluctuating requirements of the combustion system.



...saves power!

The above chart plainly shows the power savings which Sturtevant Vane Control enjoys over damper control. As the vanes close, the volume of air handled in the system is reduced —and the lessening fan output directly affects the input of the motor. Power savings are proportionate to the periods during which the system does not operate at full capacity. The majority of power plants have now adopted this form of control for their mechanical draft fans. It is also in demand for all types of industrial applications where fans are subjected to variable loads.

Let Sturtevant Help You Solve Your Post-War Draft Problems—*NOW!*

Today almost every utility and industrial power plant operator is faced with the tough task of producing power with equipment old before its years. Tomorrow there's going to be a *rush* to replace obsolete equipment. Sturtevant is ready to give you a head start now . . . to work with your plant engineers or post-war planning committee—without obligation. Sturtevant makes both Forced and Induced Draft Fans in the right types and sizes to meet all boiler and combustion specifications. They have established records for efficiency and economy in outstanding plants throughout the nation. Let our engineers work with you *now* to get *on the boards* the Sturtevant products you will need tomorrow.

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Model "WTN-W" Relief Valve
A top guided, high capacity, liquid or vapor relief valve, available in standard sizes up to 6"; in both iron and steel body types. Trim to suit service. This valve is noted for efficient day-in-day-out dependability, and low maintenance cost. For pressures up to 600 lbs. per sq. in.

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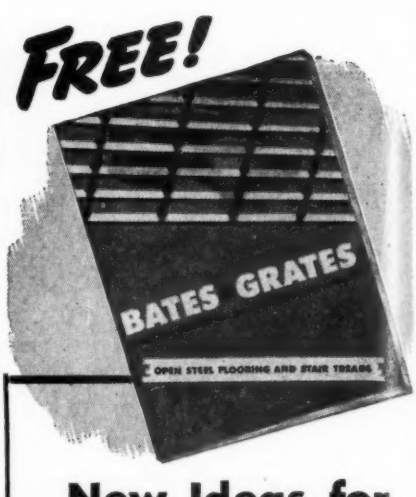

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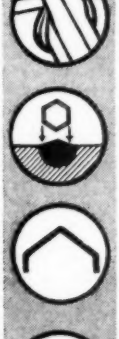

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And here's an important point to remember—wherever your plant is located, you're close to a complete Bowser service organization. BOWSER, INC., Fort Wayne 5, Ind.

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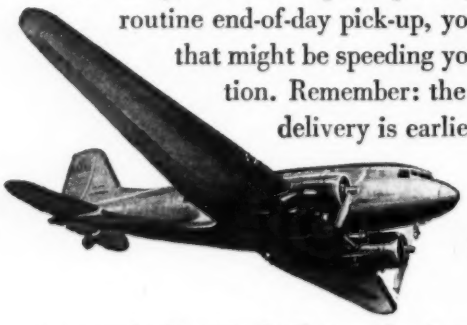

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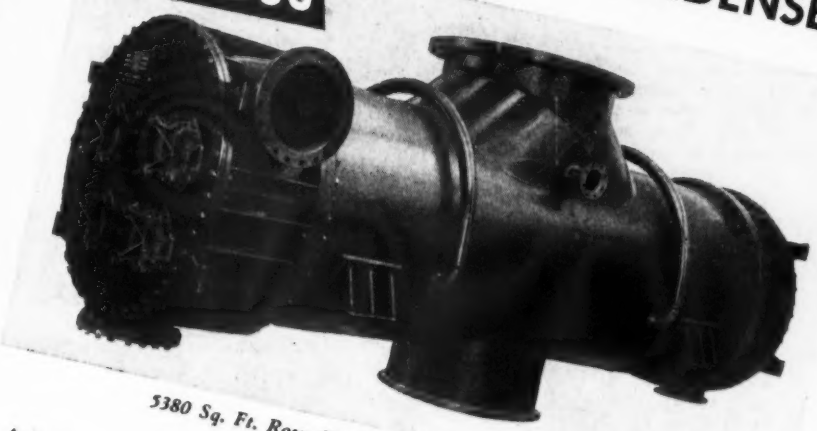

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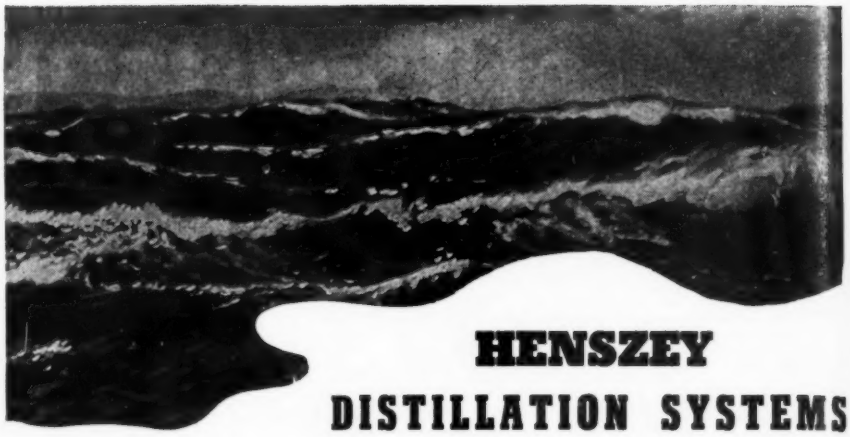

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And that's important if you need an abundant supply of absolutely pure water for:

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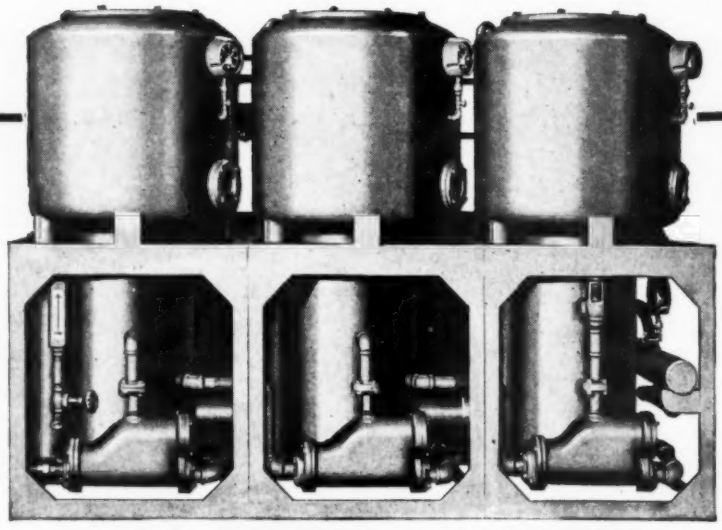

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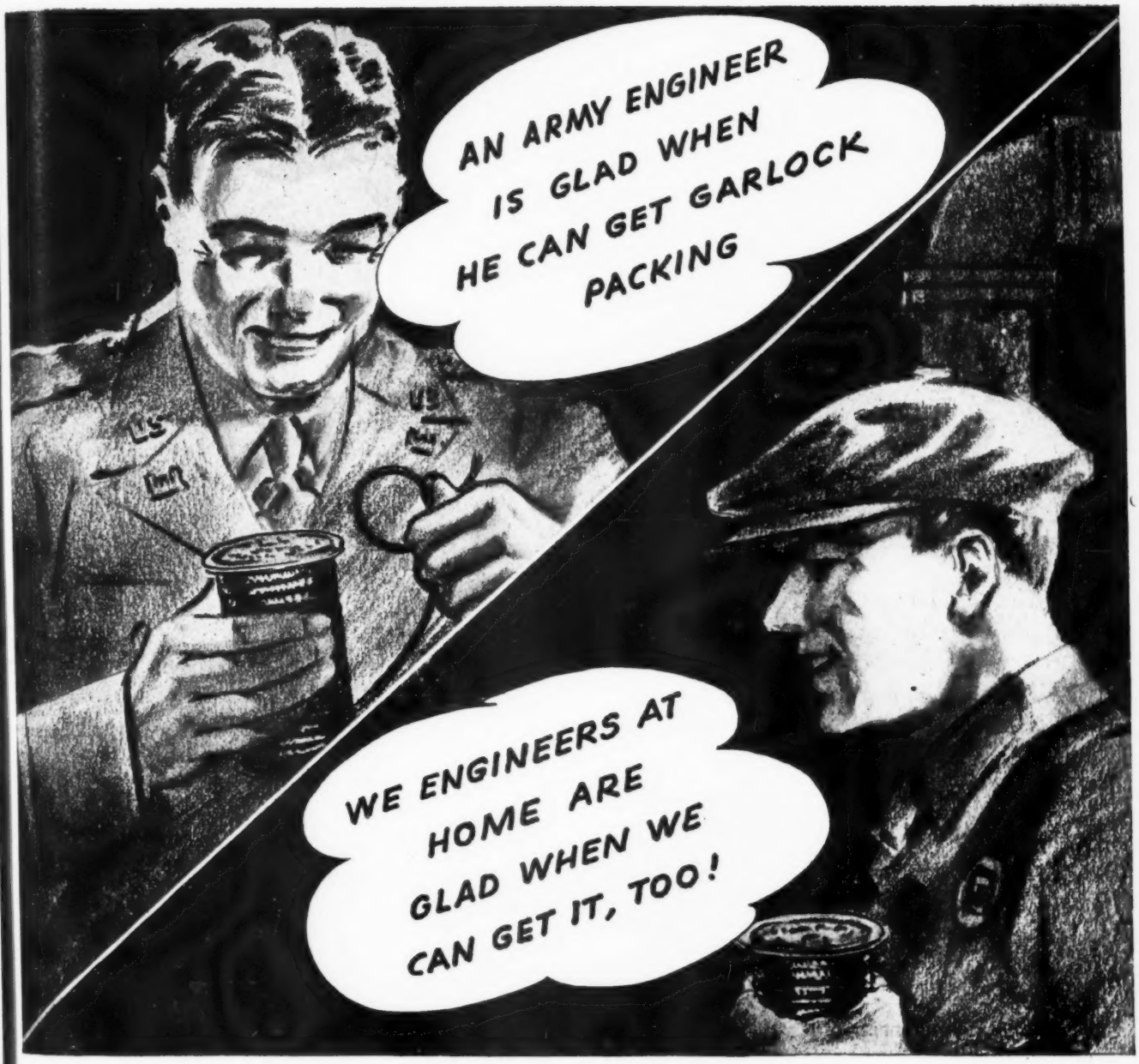

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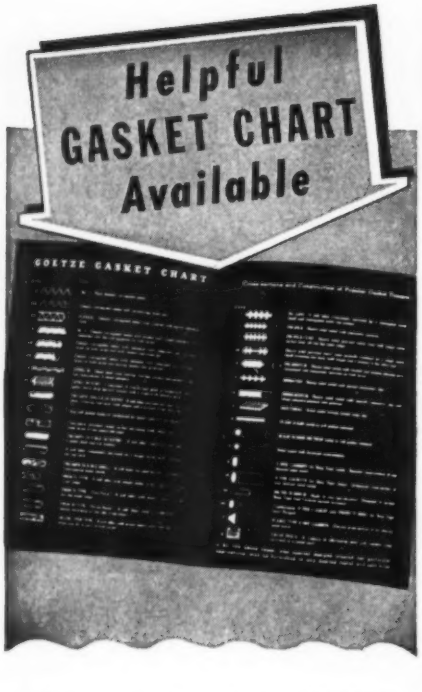

An up-to-the-minute Gasket Chart showing the cross-sections of 36 most popular Gasket Types, their purposes and the characteristics which fit them for the specific services intended, is now available to interested engineers.

This chart has been issued as the third in a series of technical papers on Gaskets compiled by the Research Laboratory of the Goetze Gasket and Packing Company, Inc., oldest and largest manufacturers of industrial gaskets in America.

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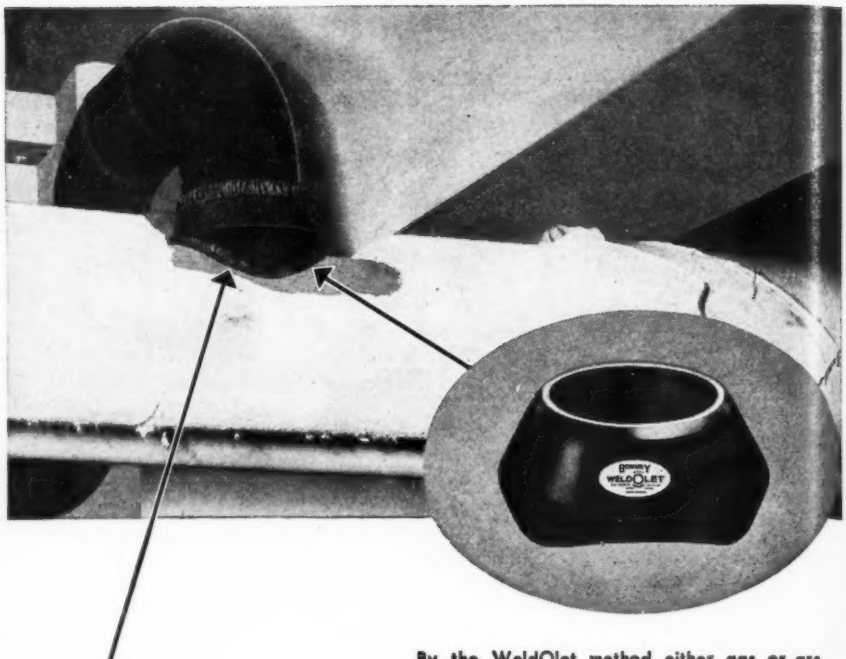

By the WeldOlet method either gas or arc welding produces a branch pipe junction of full pipe strength. The steps are simple: Position fitting on main pipe; Weld solidly in place; Cut and remove the button; Attach the branch pipe.

How to make branch pipe outlets without cutting the main pipe

3 TYPES MEET EVERY NEED

WELDOLET— Beveled outlet for welded branch pipe connection.

THREDOLET— Threaded outlet for screwed connection of branch pipe.

SOCKET-END WELDOLET— Bored outlet to outside pipe diameter for welded branch pipe connection.

This is an extremely awkward place for a branch pipe outlet. But the installation was made quickly and economically by the WeldOlet method. A minimum of insulation was removed from the pipe—no templates were used. The main pipe did not have to be cut and the finished joint is as strong as the main pipe.

Thus, what is usually a time-consuming job is done quicker and more economically than by other methods. When you use the WeldOlet method, fittings are low in first cost, low in installation cost. Pressure loss is less because of the extra wide funnel shaped opening in the fitting where it joins the main pipe. Size-to-size and reducing sizes are available from ¼" to 12". For full information write for Branch Pipe Outlets Catalog WT31.

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For Welded Branch Pipe Outlets

FOR CRANES AND HOISTS

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Does Away with Dangerous . . . Fixed . . . Open Wire Conductors

With Industrial Trol-E-Duct the bus bars which carry current to your hoists and cranes and other moving loads — or to your portable tools — are all enclosed in a safe, clean, rigid casing which comes in 10-foot factory pre-fabricated interchangeable sections (straight or curved), giving you a safe, dependable, constant and conveniently flexible power system.

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End view of the safe, rigid, duct-enclosed bus bars and trolley current collector.

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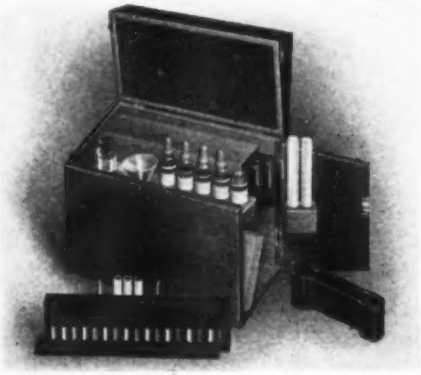

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Permits Accurate pH and Phosphate Control

This outfit enables power plant engineers to keep frequent and accurate check on the pH and Phosphate content of boiler water with a minimum of time and trouble. Tests can be made on the spot just as easily and efficiently as in a laboratory, and your simple, speedy determinations will be absolutely accurate, for all Taylor liquid color standards carry an UNLIMITED GUARANTEE AGAINST FADING. *Outfit is available in 2 models, each with a base and slides of durable, non-warping plastic. Both models come with compact carrying case.*

Model P—for control of phosphates only $26.00
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Prices are F.O.B. Baltimore

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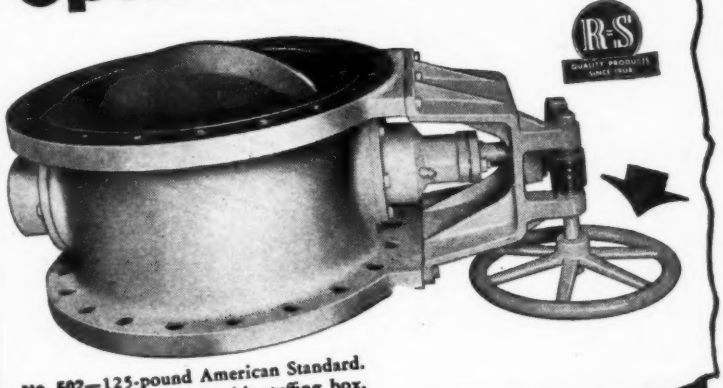
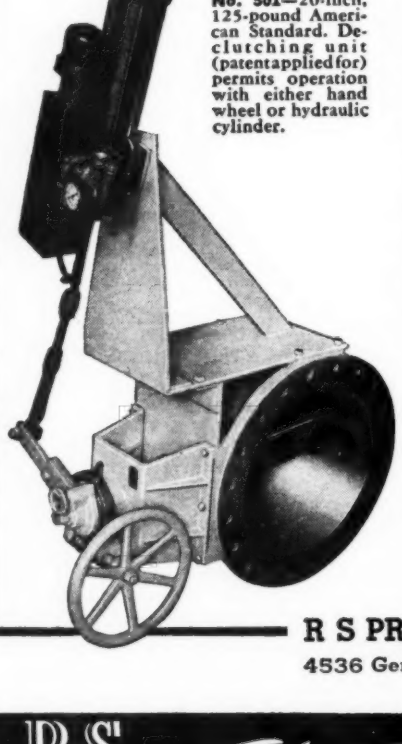
4 to 6 Hand Wheel Turns Open or Close Valve



No. 502—125-pound American Standard. Ball bearing mounted with stuffing box.

The quick operation of R-S Butterfly Valves is readily apparent. This is an important feature in any application but it is especially important where a battery of synchronous-driven pumps discharges into a common header. Burned-out motors at start-ups can be practically eliminated when R-S Butterfly Valves are installed, since it requires only a few seconds of an operator's time to shut off the discharge valves until the pump has gained the desired speed. The valves are then opened gradually, of course.

Equipped with hand wheel or chain wheel control, the standard 125-pound valves not only fulfill all requirements to better advantage, but cost less to purchase and install than conventional type valves.



No. 501—20-inch, 125-pound American Standard. Declutching unit (patent applied for) permits operation with either hand wheel or hydraulic cylinder.

NO SLAM—NO LINE DAMAGE

The 125-pound valve, equipped with hydraulic cylinder for power operation, prevents a synchronous-driven pump from grabbing all the load when the pump is started, prevents reverse flow and eliminates water hammer since the valve cannot move any faster than the bleeding of the cylinder discharge permits.

Straight-through flow—control and shut-off for any material that flows or is forced through a pipe.

Constructed in sizes to 84-inches and for **15 to 900 psi.** Write for Catalog No. 14-B.

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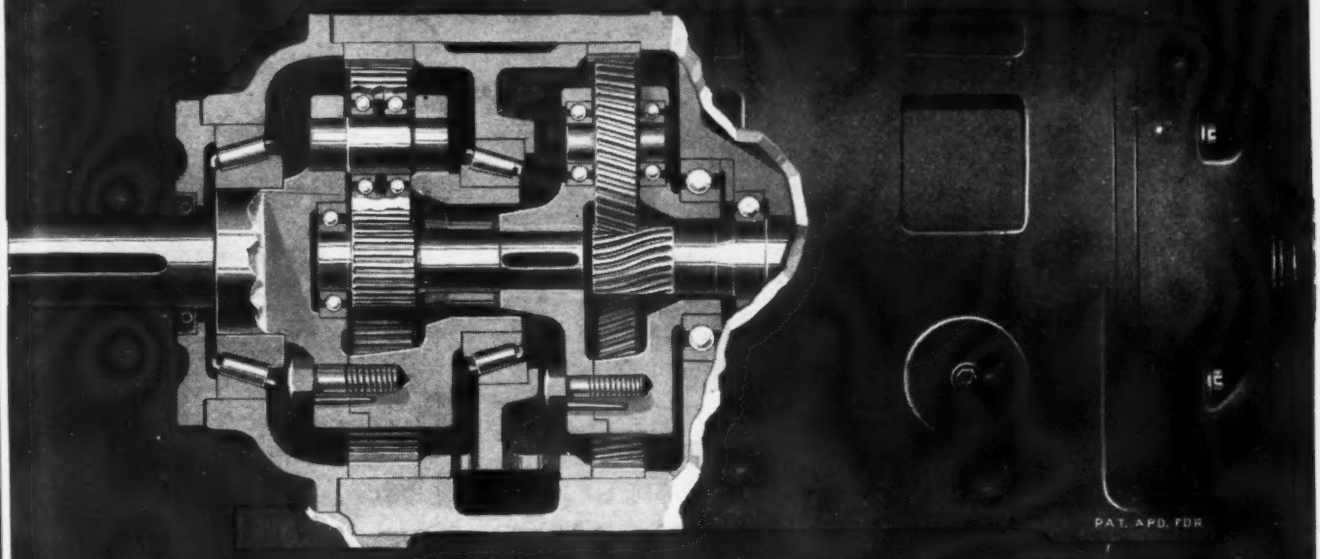
R-S Streamlined BUTTERFLY VALVES

NO OVERHUNG PARTS



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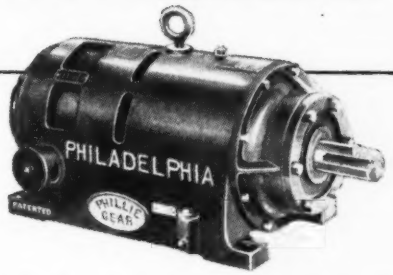

...Drive operates without Vibration

Both the horizontal and vertical MotoReduceR combine a motor and planetary speed reducer in a single housing. This results in an attractive streamlined effect that enables the MotoReduceR to blend with, and appear to be an integral part of any machine on which it is installed. More important though is the resulting better alignment of pinions and gears, which reduces noise and wear and conserves space. *Because there are no overhung parts, vibration is eliminated and proper tooth alignment is maintained at all loads.* All parts, however, are readily accessible.

The MotoReduceR will operate efficiently for years, without any attention except periodic changes of lubricant.

A wide range of sizes and ratios are available with standard A.G.M.A. ratings.

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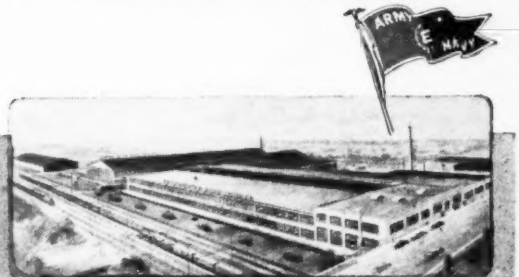
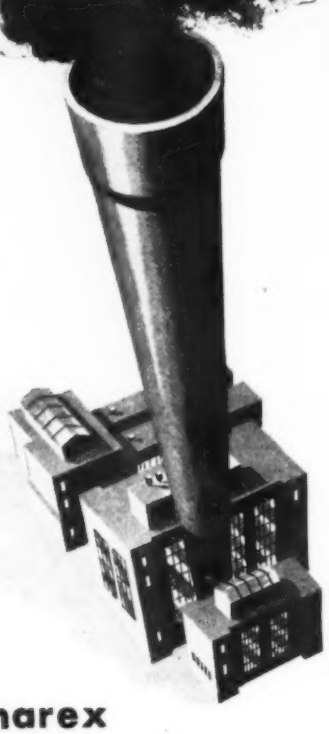


Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Stop wasting this heat!



Ranarex cuts up-the-stack loss as much as 20%

Here's a simple way to get more power from the fuel you burn: Just measure the CO_2 in flue gas with the Ranarex* instrument. Then regulate combustion until percentage of CO_2 is at the point known to be just right for your load. Ranarex gives instant, accurate readings—yet it contains no fragile parts and doesn't get out of order easily.

GET FREE BOOKLET!

Write today to The Permutit Company, Dept. A, 330 W. 42nd St., New York 18, N. Y. In Canada: Permutit Company of Canada, Ltd., Montreal.

*Trademark Reg. U. S. Pat. Off.

PERMUTIT'S

RANAREX

BLIZZARD that stops fire cold!

THE

Randolph "4"

CARBON DIOXIDE FIRE EXTINGUISHER

ONE HAND ACTION

Portable, lightweight, Randolph "4" is designed for one-hand, self-aimed operation. With no hoses to twist, valves to turn, horns to raise—this extinguisher is PANIC-PROOF. Protection for shops, shipyards, power plants.

RANDOLPH "2"

Ready to combat sudden "flash" fires. This compact, small unit, with exclusive Randolph design, is *especially* adapted for bracketing in BUSES, TRUCKS, CARS, and MARINE CRAFT.

Foresighted safety engineers demand *streamlined, mobile* fire protection. And *first* in their line of defense is portable carbon dioxide. Randolph "4" . . . the modern extinguisher . . . speeds fire-fighting—kills electric, machine, flammable liquid fires with quick, easy action. Just a touch of the trigger—and powerful carbon dioxide charges into the flames, smothers the blaze in a penetrating, icy blanket.

Randolph carbon dioxide is SAFE. It does not conduct electricity or damage equipment . . . will not deteriorate, and is effective in extreme temperatures. *Approved and labeled by Underwriters' Laboratories, Inc.*

Mobilize against fire with Randolph "4". For prompt delivery *without priority*, 'phone your supply house, or write us—today.

SEND NOW *for new, free booklet "Sharpshooting at Flames." Illustrates latest techniques in carbon dioxide fire-fighting.*

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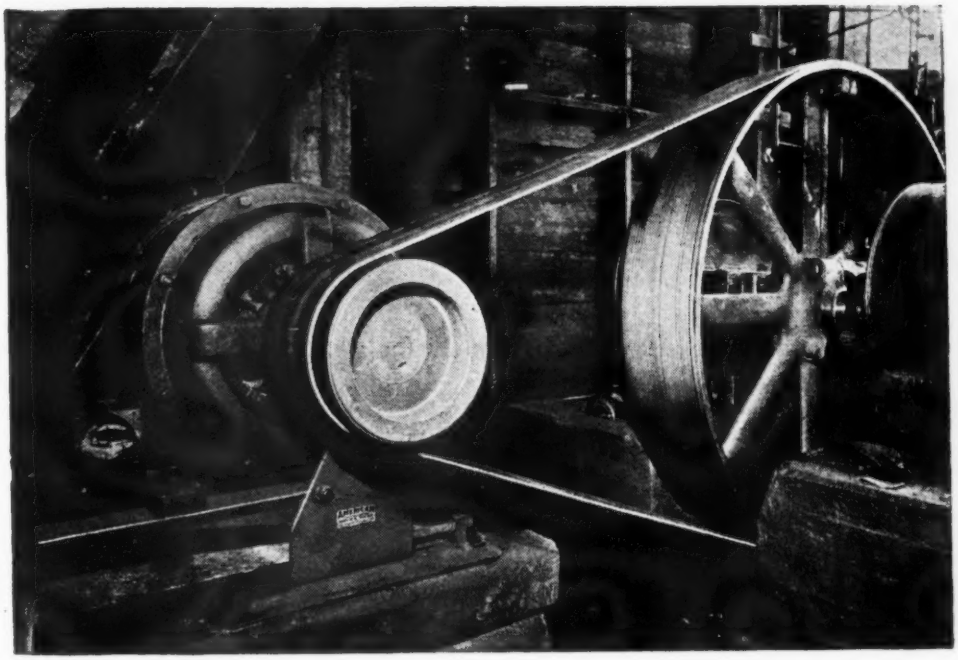
ADDRESS_____

RANDOLPH LABORATORIES *INC.*

8 EAST KINZIE ST., CHICAGO 11, ILLINOIS

This Drive Makes One Belt Outlast *Five*...

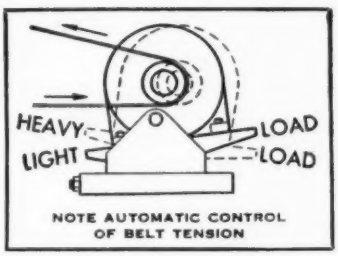


American Econ-o-matic Drives, with automatic belt tension control, offer you benefits and economies no ordinary drive can give you. Here is a good example:

Up to 1938, the compressor shown above was operated by a drive equipped with an idler pulley to maintain belt tension. Belts—and they cost $57.60 each—wore out in a year. Moreover, an average of three hours a week in maintenance time was required to keep the drive in operation.

In 1938 this compressor was equipped with an American Econ-o-matic Drive and a new belt installed. The belt hasn't been changed since and is still in good condition. One belt instead of five—$288 saved—and no shutdowns due to drive failure!

You have no belt tension problem when you use American Econ-o-matic Drives. Nothing "magic" about them—Econ-o-matic Drives merely utilize the torque reaction of the motor to automatically match belt tension to the load. On a heavy load, belt tension is increased. On a light load, belt tension is decreased. No slide rails nor idlers to adjust. It's automatic!



NOTE AUTOMATIC CONTROL OF BELT TENSION

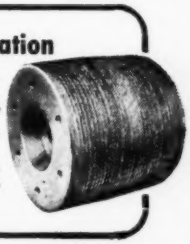
Belt slip is eliminated. Belt and bearing life is increased. As many as 3 out of 4 drive maintenance man-hours are saved. And machine output is stepped up as much as 15%. The only way you can get automatic belt tension control is by equipping individually driven machines with American Econ-o-matic Drives. Write for your copy of the new Econ-o-matic Drive Handbook. It gives you complete drive tables, specifications and installation instructions.

The American Pulley Company

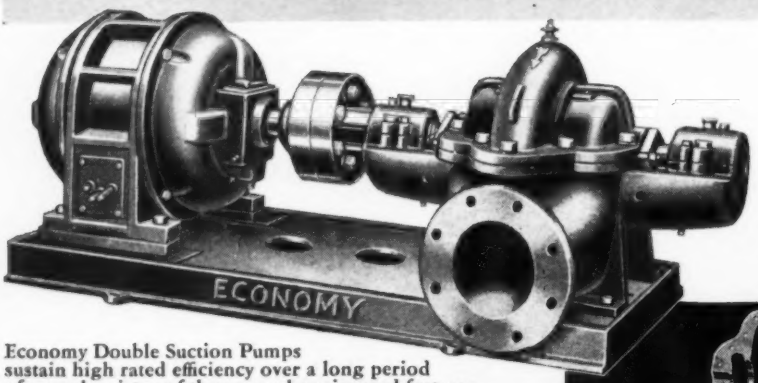
4224 WISSAHICKON AVE., PHILADELPHIA 29, PA.

An Ideal Pulley Combination

American Steel-Split Pulleys and Hi-Torque Motor Pulleys are a true-running "team" that give you highest gripping power... longer life... exceptional accuracy... dependable service. Write for catalogs.



QUICK CLEAN-OUT, INSPECTION OR REPAIR
...WITHOUT BREAKING PIPE CONNECTIONS!



Economy Double Suction Pumps sustain high rated efficiency over a long period of years by virtue of the unusual engineered features.

- **Rotor supported between two liberal outboard bearings—giving longer life than is possible with overhung construction.**
- **High efficiency compared with other types, because inlet dia. can be kept small while leakage and friction losses are considerably reduced.**
- **All parts subject to wear are readily removed, without disturbing alignment of unit or pipe connections.**
- **End thrust is almost negligible—thus bearing construction is very much simplified.**

These, and many other Economy advantages, are fully described in free descriptive literature. Write for your copy of Bulletin 408 today.

ECONOMY HORIZONTALLY SPLIT CASE PUMP PROVIDES EASY REMOVAL OF VITAL PARTS.

ECONOMY PUMPS, INC.
HAMILTON, OHIO, U. S. A.

Stockpile Coal
the Safe, Easy
SAUERMAN WAY!

Costs only a few cents per ton handled!

ENGINEERS and superintendents of power plants large and small where coal is being stored and reclaimed with SAUERMAN Power Scrapers say that this equipment is giving them a maximum of satisfaction.

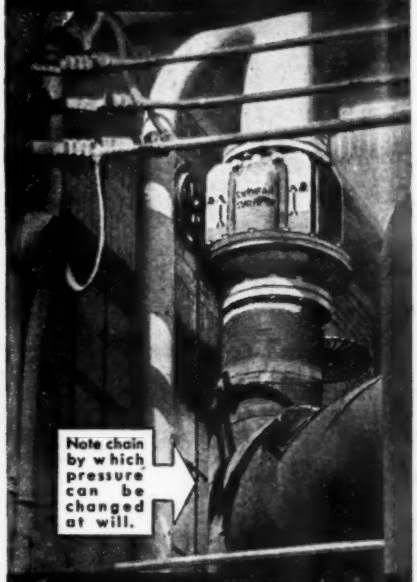
These machines operate rapidly and economically. The operator is housed in a comfortable control station where he has a view of the entire storage area. The operation is automatic except that a few minutes of manual labor is required to change the operation from storing to reclaiming, or vice versa. Repair demands are few and far between.

Coal is stacked layer on layer to any height. This method of storing produces a pile that is perfectly homogeneous and safe from the danger of spontaneous combustion.

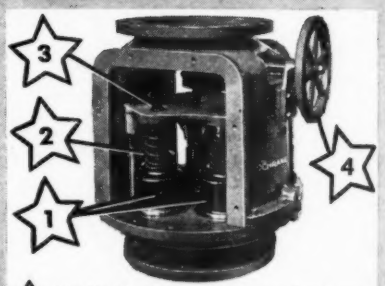
Catalog shows many different layouts. Write for it.

SAUERMAN BROS., Inc.
562 S. Clinton St., Chicago 7, Illinois

SAFE!
NO STICKING—NO JAMMING



ADJUSTABLE
EASILY and QUICKLY



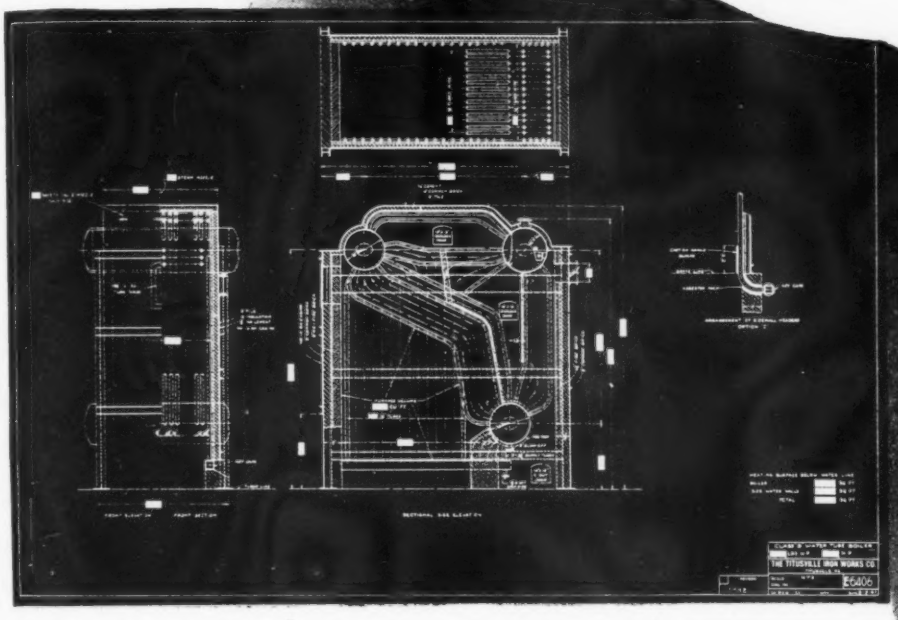
1. Multiple valve disks, instead of one large disk.
2. Individual lifting spindles and hold-down springs.
3. Pressure Plate by which predetermined pressure is adjusted.
4. Adjusting hand wheel. This can be operated by hand, chain or motor.

Write for Publication 2870 for complete data.
COCHRANE CORPORATION • 3106 N. 17th STREET
PHILADELPHIA 32, PA.

COCHRANE
MULTIPORT
RELIEF VALVE

TITUSVILLE WATER TUBE BOILERS

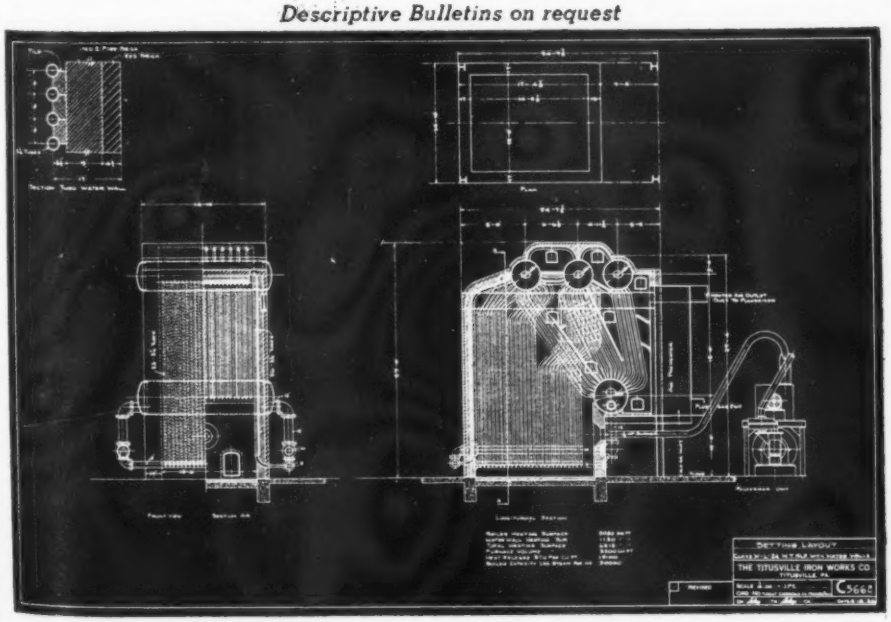
for
DEPENDABLE STEAM GENERATION



TITUSVILLE Water Tube Boilers—serve America's Armed Forces all over the world with the same efficient, safe, dependable performance they have provided leading industrial and institutional applications for more than *fifty years*.

When you are confronted with a boiler problem, for any service, new or replacement,—TITUSVILLE engineers will gladly cooperate—anytime, anywhere.

Descriptive Bulletins on request



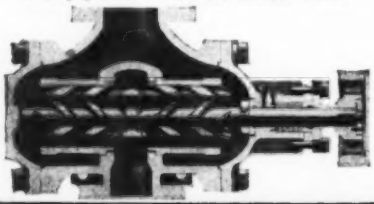
STRUTHERS WELLS CORPORATION
TITUSVILLE BOILER DIVISION
TITUSVILLE, PENNA.
Plants at TITUSVILLE, PENNA. and WARREN, PENNA.

The IMO OIL PUMP
Small but Effective

LIKE THE SUBMARINE ON WHICH IT IS USED

The submarine represents the most concentrated power known to naval warfare. Similarly, the IMO oil pump provides great concentration of pumping capacity in small space. It is extremely compact, rugged, simple and reliable, having only three moving parts and no valves or pilot gears.

The IMO oil pump is used on submarines for pumping both fuel and lubricating oils. You can use this small, but effective, pump for handling oil of practically any viscosity, in any volume, and at any pressure. Ask for Leaflet I-112.



IMO PUMP DIVISION
of the De Laval Steam Turbine Company
Trenton 2, New Jersey

Your Up-to-date

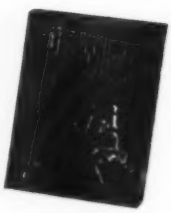
HANDBOOK

of the

Latest

in Power-field

Practice



USE EVERY ISSUE

HENSZEY
FEED WATER METERS

There are hundreds of Henszey Meters serving in many different war industries. Their unique rugged construction without close clearances and with a minimum of working parts have enabled them to stand up under conditions that quickly break down ordinary meters. Henszey Meters are equally accurate at high or low flow—high or low pressures—on reciprocating or centrifugal pumps. Calibrations can be made to read in gallons, pounds or cubic feet at any specified temperature. They can be installed right in the line.

Check List

Use Henszey Meters for measuring

- ☐ BOILER FEED WATER
- ☐ HOT DIRTY BLOWDOWN
- ☐ CONDENSATE
- ☐ FREE RUNNING CHEMICALS
- ☐ OTHER "HARD TO MEASURE" LIQUIDS

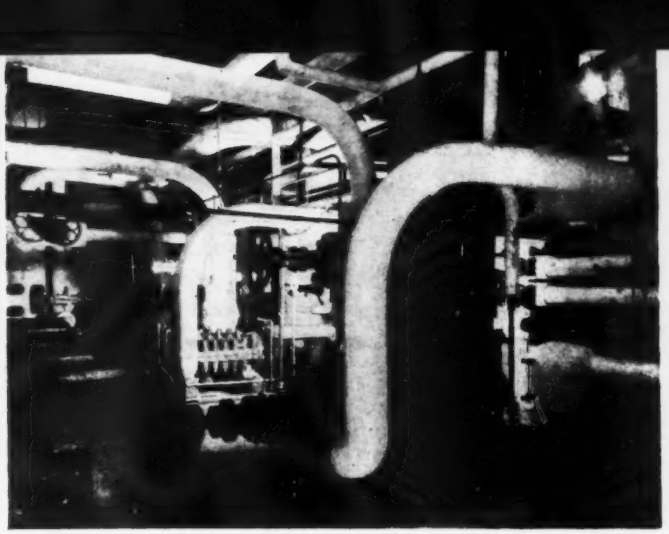
Consider Henszey Meters for your liquid measuring problem! Write for full information.

HENSZEY CO. Dept. *D-5* Watertown, Wis.

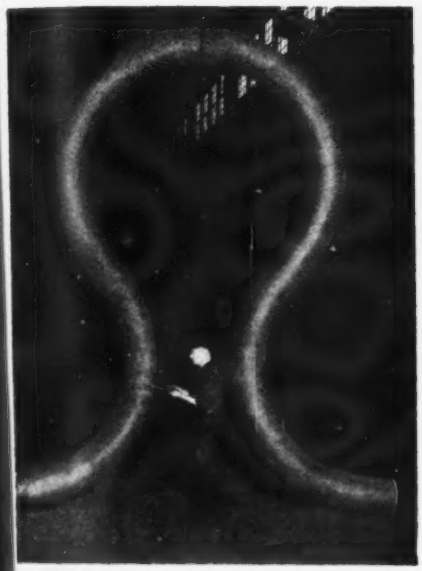
HENSZEY
FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Flow Indicators • Boiler Feed Regulators • Proportioning Valves

Miscellaneous Pipe Bends



Pipe Bends in Completed Systems



Double Off-set "U" Expansion Bend

Double 90° Pipe Bend

PIPE BENDS • DOUBLE OFFSET "U" EXPANSION BENDS

Tailored to fit Installation Requirements

by Pittsburgh Piping and Equipment Company

WHEN planning and designing piping systems for additions, alterations, or new installations, consider the advantages of incorporating pre-fabricated pipe bends instead of fittings.

Pipe bends can be made to any desired length and a number of bends can be made into a single length of pipe so as to produce a tailor-made pipe connection that will fit exactly into the space available.

The following advantages are obtained by the use of Pittsburgh Piping & Equipment Company's pre-fabricated bends.

1. Reduction in number of welds saves time both in shop fabrication and field erection.

2. Good distribution of field welds is obtained and welds can be confined to areas not subject to high bending stress.

3. They provide flexibility in piping systems subject to thermal expansion.

4. Long-radius Bends reduce footage of pipe in certain runs . . . also reduce pressure drop caused by internal pipe friction.

5. They are tailored to fit installation conditions . . . no interference with other piping or auxiliary equipment.

6. The result is a neater, more compact, highly efficient, and economically operated system.

Our engineering department will be glad to show you how and where this type of fabrication can be used to advantage. Contact our nearest representative or write us direct. There is no obligation.

ARMY E NAVY

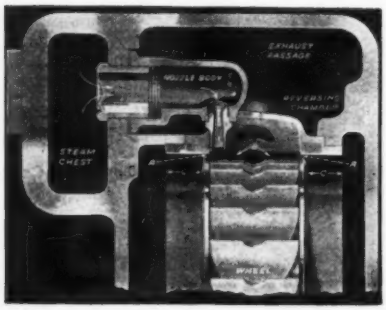
Pittsburgh Piping

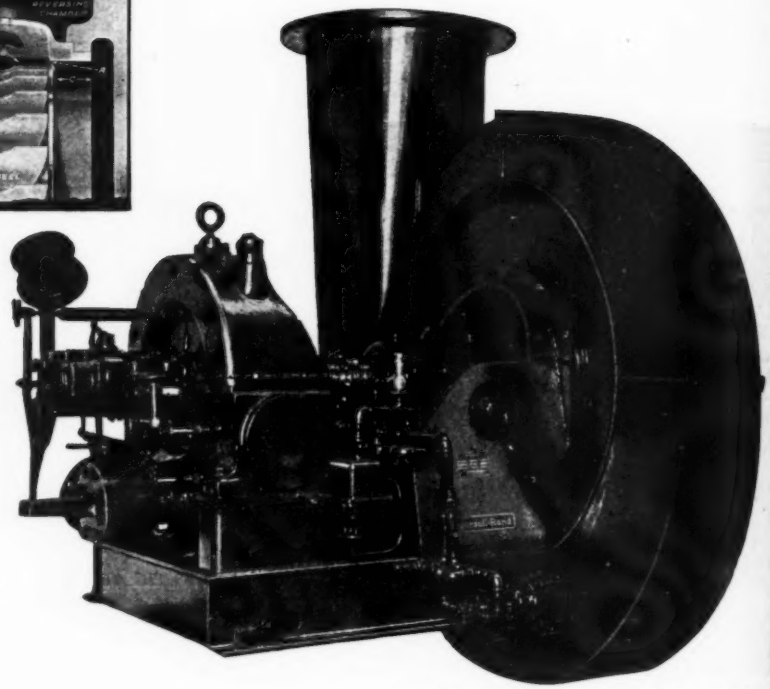
AND EQUIPMENT COMPANY

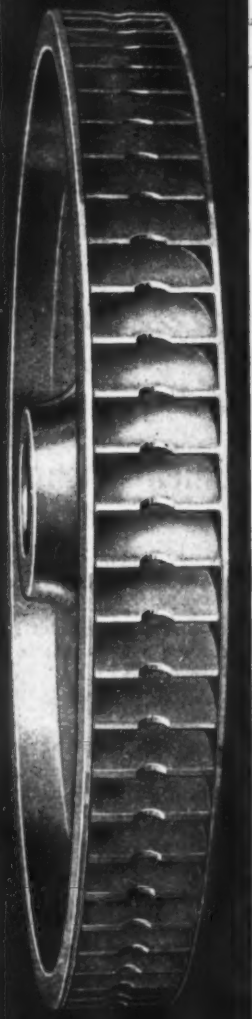
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Peoples Gas Building, Chicago
Occidental Building, Indianapolis
Public Square Building, Cleveland
Book Tower, Detroit
10 High Street, Boston
525 Market Street, San Francisco

TERRY







ABOVE:

Terry Wheel Clearances. A—Rim Clearance. B—Large Blade Clearance. C—Side Clearance (about one inch).

AT RIGHT:

Typical Terry Solid Wheel Turbine direct connected to a blower.

THE BLADES ARE DOUBLE RIM PROTECTED IN THE TERRY SOLID WHEEL TURBINE

In the Terry Turbine the blades have large clearances and are further protected by the projecting rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the radial clearance became reduced.

End play can do no damage to the blading as the side clearance is very large (about one inch). There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

The Terry solid wheel turbine is described in our Bulletin S-116.

A request on your business letterhead will bring a copy.

T-1166

THE TERRY STEAM TURBINE COMPANY

TERRY SQUARE, HARTFORD, CONN.

Planning the designs for tomorrow's

KEROTEST

Dependable Valves

With the "KNOW-HOW" Gained Through Years of Experience On Diversified INDUSTRIAL APPLICATIONS

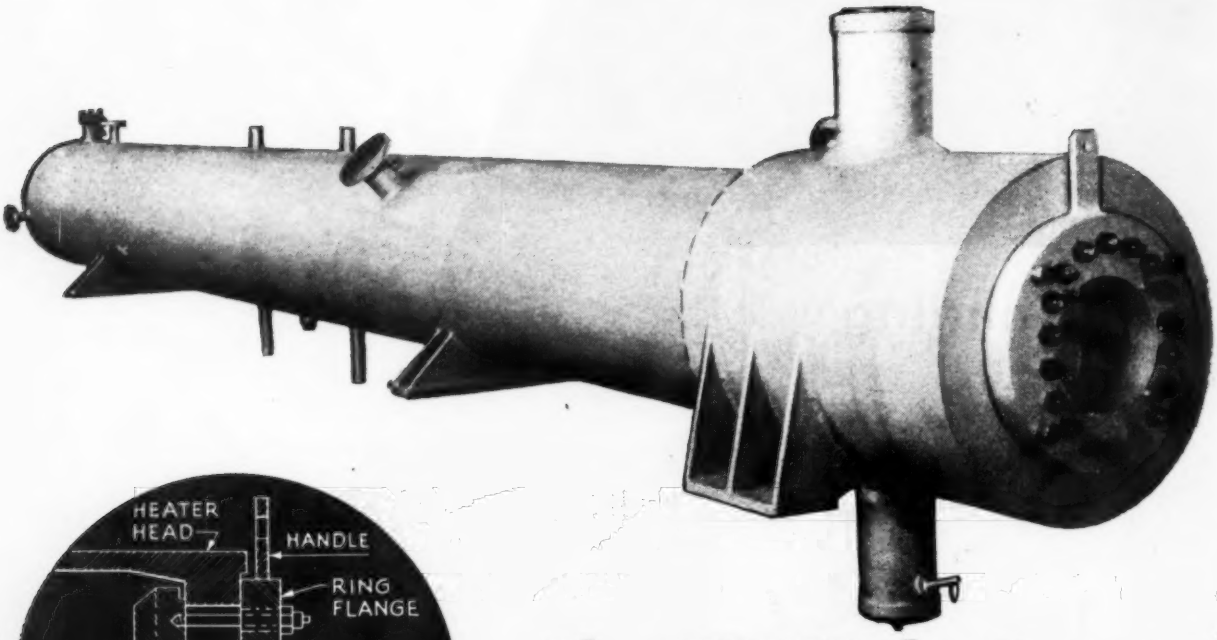
should have a
y of this inform-
e Kerotest cata-
in your files for
ent and post war
rences.

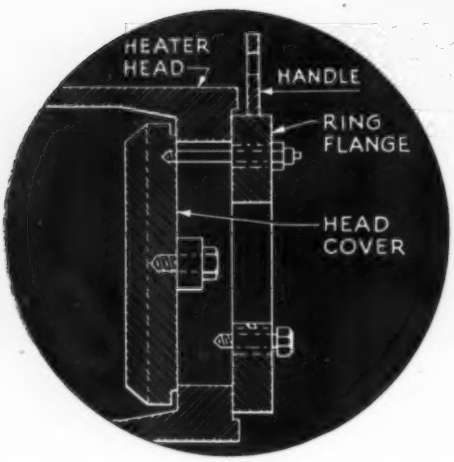
We at KEROTEST know well the desperate pressure and rush of war production—we're serving tirelessly to meet America's needs for dependable precision built valves. But NEVER in this emergency has KEROTEST'S quality standard been sacrificed for speed. Greatly increased facilities?—Yes. Add and train thousands more men?—Yes. Engineering and research staff on a "round-the-clock" offensive?—Yes. But lower the standard of KEROTEST dependability and precision?—NEVER.

With peace, the rigid adherence to this sound policy will again mean much in the adaption of KEROTEST Dependable Valves to your industrial valve control requirements.

KEROTEST MANUFACTURING COMPANY

PITTSBURGH, PENNSYLVANIA



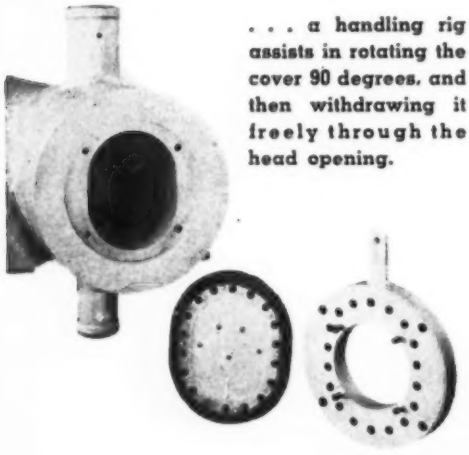


The HIGHER the Pressure The TIGHTER the Seal . . .

in the G-R

Type M BLEEDER HEATER

READILY REMOVABLE



. . . a handling rig assists in rotating the cover 90 degrees, and then withdrawing it freely through the head opening.

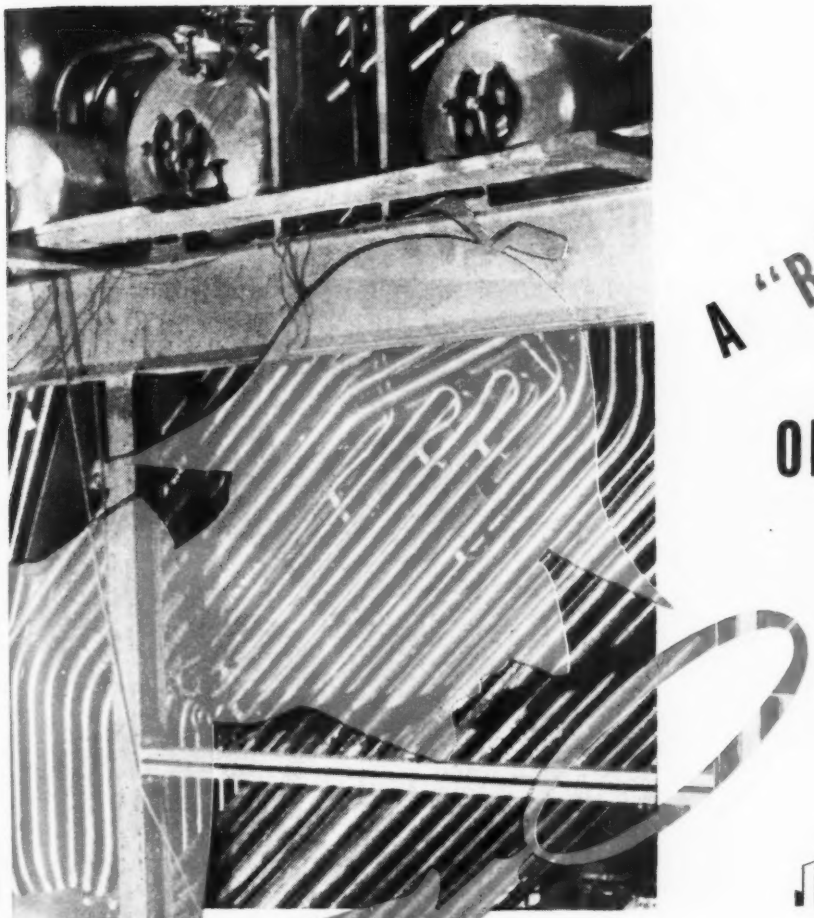
In this exclusive design of bleeder or stage heater, the water pressure *helps* to hold the cover tight against the head. Therefore, heavy bolts or studs are not required to maintain tightness, as in most designs; and leakage or seepage need never occur.

This design combines simplicity with effectiveness on high-pressure service, for it includes only two parts; the "manhole" cover and a ring flange. Other G-R designs with similarly advantageous features are available for moderate and low pressures. Bulletin on request.

THE GRISCOM-RUSSELL CO.
285 MADISON AVENUE, NEW YORK 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



A "BAFFLING" CASE... OF BOILER CORROSION

Serious corrosion in the steam drum of a boiler which had been in service only a year was being encountered by a Wisconsin central station. Betz engineers were called in to determine the cause of the trouble and to make recommendations for its elimination.

Internal inspection of this boiler revealed an unusual condition wherein the corrosion was confined to only a certain section of the steam drum, and the dry pipe and internal baffles in this section were literally flaking away. The products of this corrosion were identified through X-ray and chemical analysis as magnetic oxide of iron. Tests of the boiler water itself revealed that improper deaeration at the feedwater heater was allowing excessive quantities of dissolved oxygen to enter the boiler. However, the curious localization of the corrosive action was found to be due to unbalanced heat flow caused by incorrect furnace baffling coupled with improper flue damper adjustment. Recommendations were made for the proper operation of the deaerating heater, and through cooperation with the boiler manufacturer steps were taken to correct the unbalanced heat flow.

Although this case is somewhat unusual, it does illustrate how W. H. & L. D. BETZ renders a complete service on boiler water conditioning.

CHEMICAL ENGINEERS AND CONSULTANTS
ON ALL WATER PROBLEMS

W. H. & L. D. BETZ

FRANKFORD • PHILADELPHIA • PENNA.

THAT'S WHAT I CALL A LUBRICATION JOB

The LUBRIPLATE film is tough . . . the toughest lubricating film you have ever used. It holds contacting surfaces apart, even under the heaviest loads, thus effectively preventing progressive wear. Examination of a bearing surface lubricated with LUBRIPLATE always shows a mirror finish.

LUBRIPLATE is a most exceptional lubricant. It keeps friction down to a minimum, thus conserves power. It prevents rust and corrosion. Its effective life is longer than conventional lubricants, therefore it is more economical to use.

The remarkable achievements of LUBRIPLATE are told in the "LUBRIPLATE FILM." It contains case histories and general lubricating information written especially for your industry. Send for a copy today.

℞ FOR YOUR MACHINERY

No. 3—Ideal for general oil type lubrication. Ring oiled bearings, wick feeds, sight feeds and bottle oilers.

No. 8—Because of its high film strength and long life reflects outstanding performance in most types of enclosed gears (speed reducers).

No. 107—One of the most popular grease type products for general application by pressure gun or cups.

No. 70—For a wide range of grease applications, especially at temperatures above 200 degrees F.

No. 130-AA—Known nationwide as the superior lubricant for open gears, heavy duty bearings, wire rope, etc.

BALL BEARING—This is the LUBRIPLATE lubricant that has achieved wide acclaim for use in the general run of ball and roller bearings operating at speeds to 5000 RPM and temperatures up to 300 degrees F.

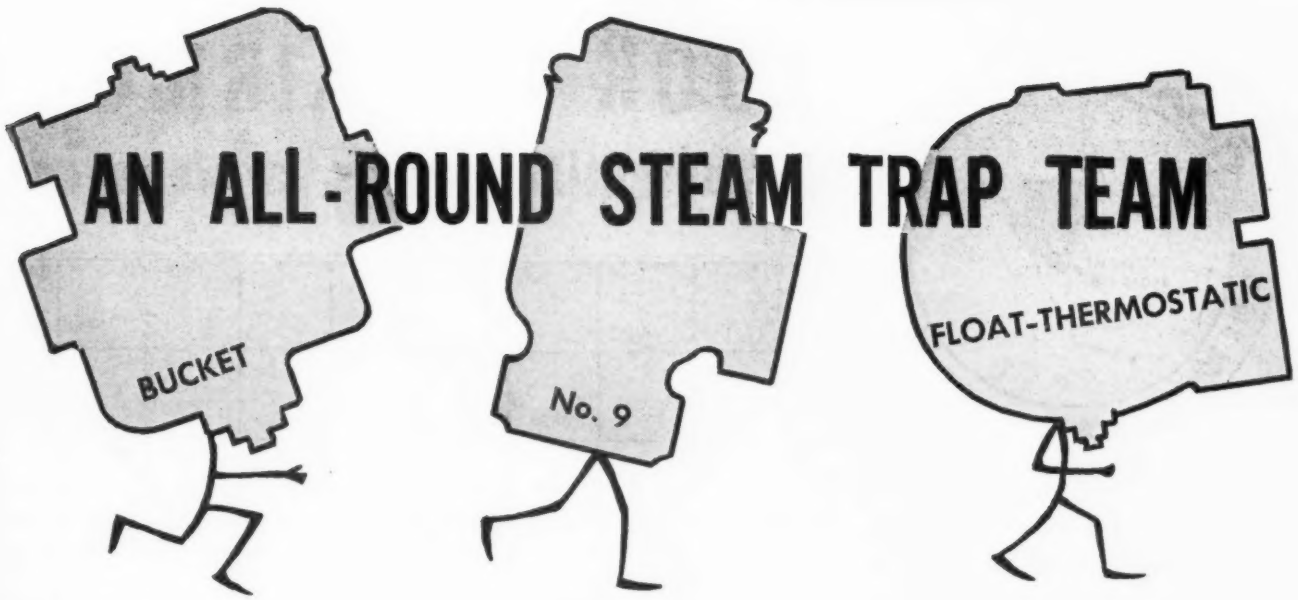
LUBRIPLATE DIVISION

FISKE BROTHERS REFINING COMPANY

NEWARK, N. J. **SINCE 1870** TOLEDO, O.

WRITE FOR THE NAME OF THE DEALER NEAR YOU

AN ALL-ROUND STEAM TRAP TEAM



Sprinter *Miler* *Cross Country*

FOR THE STREAMLINED PRODUCTION RACE

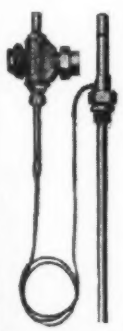
The coach of a track team never would send in a "miler" to do a "sprint". And you wouldn't expect four men who never met before to win a relay race.

Are you using the same good judgment with regard to steam traps in your plant? Just because one type of trap works well in one or two spots is no reason to standardize on that type for every job in the plant.

There are as many types of Sarco steam traps as there are runners in an outdoor meet. They are just as different. But all are aces in their own class and they know how to work together in the relay race where you use steam traps and temperature control. For instance —

The Sarco Bucket Trap is the sprinter — can speed up to take any load and is a bear for punishment. Cat. No. 350.

The Sarco No. 9 — thermostatic steam trap is like the miler, it conserves energy — can sprint on occasion, and can work on all pressures within its range. Cat. No. 250.

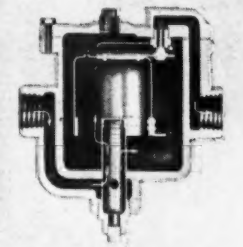


The Sarco Float-thermostatic steam trap is like the cross-country runner — it's ideal for the steady pull and particularly when used in connection with Sarco temperature control. Cat. No. 450.

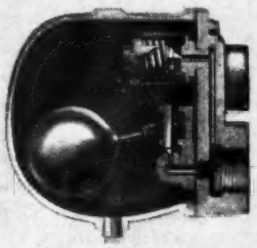
Sarco makes many types of simple self-operated regulators which work well with these traps. Get full information from the nearest Sarco representative, or write for Catalog No. 600.

TR-21

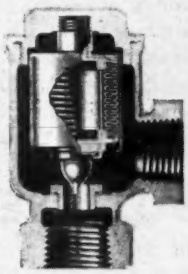
12



BUCKET



FLOAT-THERMOSTATIC



No. 9

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

SARCO

Represented in Principal Cities

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

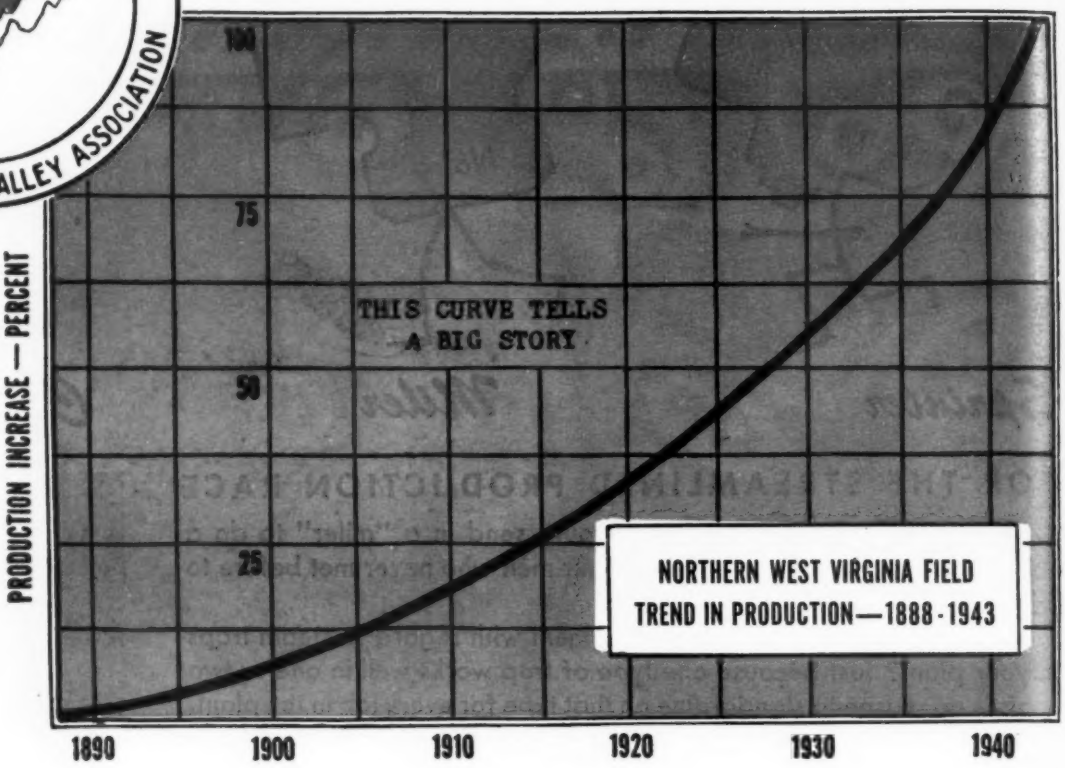
Saves Steam

LOOK TO FAIRMONT

for potential savings in steam cost

COAL BUREAU
UPPER MONONGAHELA VALLEY ASSOCIATION
FAIRMONT REGION W. VA.

★
THE RIGHT COAL— THE KEY TO LOWER STEAM COSTS
★



HUGE RESERVES + THICK COAL + MECHANIZED MINING + MODERN PREPARATION + COAL SELECTION SERVICE = ECONOMY FOR THE CONSUMER

Ask us to place you on our mailing list immediately to receive regularly copies of "Fairmont Coal" Reference Bulletins, published serially by the Coal Bureau.

In considering installation of new steam generating equipment or modernization of present plant, now is the time to look for the coal you'll use because *coal is the start from which higher efficiencies and economies must be made.*

"Fairmont Coal" Bulletins will help you to better size up your problem because they contain actual factual data on the subject in the form of case histories of modernized boiler plants, and discuss such important related subjects as coal sizing, size and price relations, preparation, selection, specifications, combustion and conservation.

COAL BUREAU FUEL ENGINEERS ARE READY TO HELP YOU

You incur no obligation in drawing on the experience of the Bureau's staff of Fuel Engineers to help you in selecting the equipment best adapted to your specific needs and in determining the proper course to pursue in evaluating fuel from a long-range standpoint. Ask for this assistance freely.

FAIRMONT COAL
PITTSBURGH SEAM
REFERENCE BULLETIN
NUMBER 4
CONSERVATION
LOW EFFICIENCY - WASTE
GOVERNMENT PROGRAM
WHAT IT MEANS

COAL BUREAU—UPPER MONONGAHELA VALLEY ASSN.

CHANIN BLDG., 122 E. 42nd ST., NEW YORK CITY

● MAIL COUPON TODAY ●

COAL BUREAU—Upper Monongahela Valley Assn.
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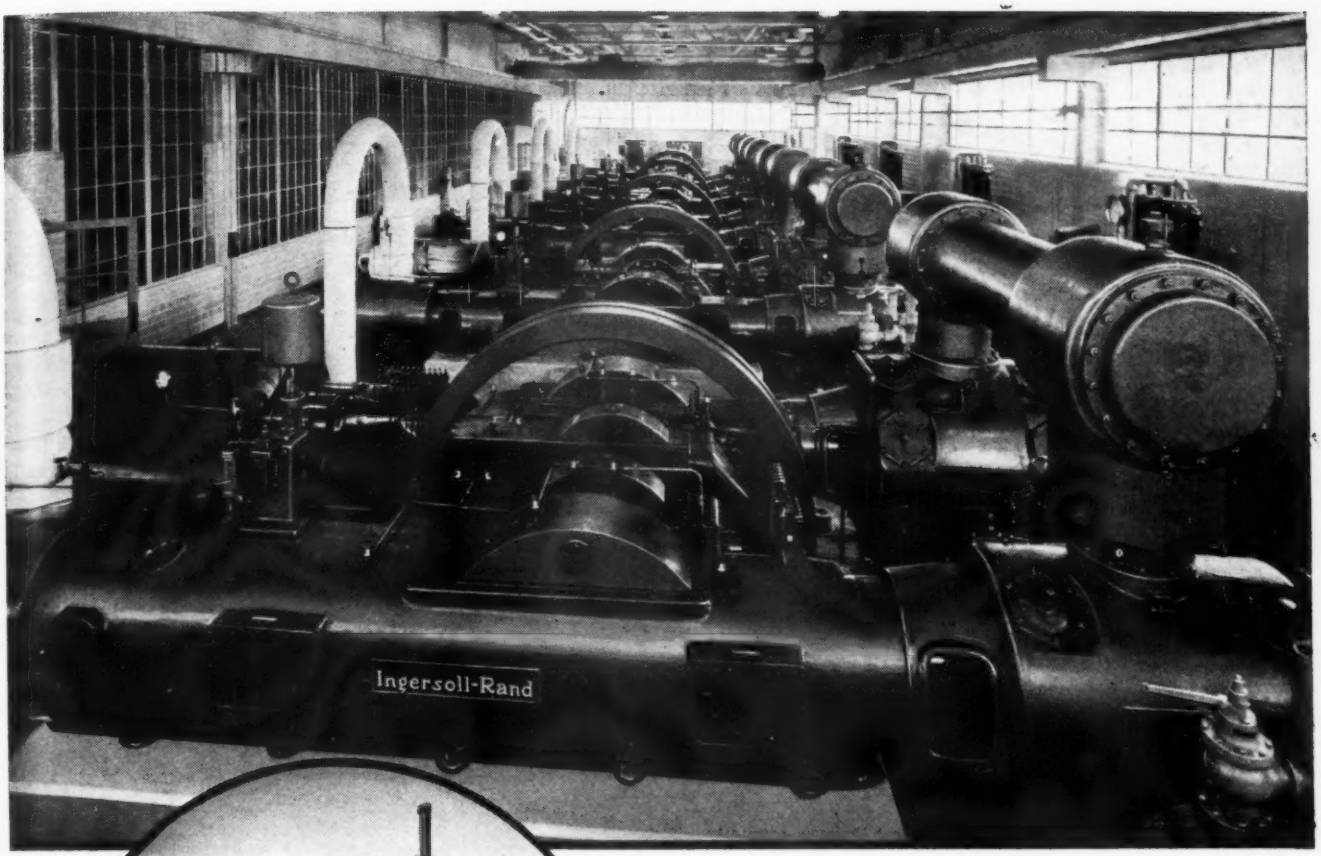
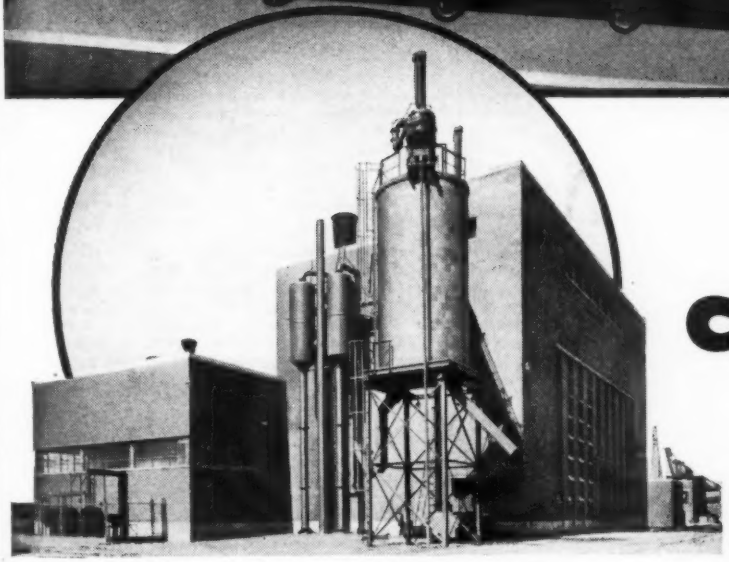
Kindly place me on your mailing list to receive copies of "Reference-Bulletins." It is understood these will be sent me FREE and without obligation.

Name .....
Company .....
Position .....
Address .....





Steam-driven COMPRESSORS *help make* Armor Plate

INGERSOLL-RAND EQUIPMENT IN THIS POWER PLANT

- Five XPV Steam-Engine-Driven Air Compressors, totaling 3700 ihp.
- Five VM-2 Aftercoolers and Air Receivers.
- Two "Disc-Flow" Barometric Condensers.
- Three Boiler-Feed Pumps.

•

In the foundry, are hundreds of I-R pneumatic tools.

The battery of five Type XPV Steam-Engine-Driven Units shown above compresses approximately 20,000 cubic feet of free air per minute to 100 lb per sq inch pressure. This compressed air operates hundreds of grinders, chippers, hoists, shot blasts, and other pneumatic equipment at the Cast Armor Plant of the American Steel Foundries. Installations such as this illustrate the vital part that compressed air is playing in the war effort.

Each of the compressors operates either condensing or with 10-lb back pressure, depending upon the low-pressure steam demand of the plant. When condensing, they exhaust into Ingersoll-Rand "Disc-Flow" Barometric Condensers, which are supplied with canal water. As needed, exhaust steam is used for general heating and ventilation, domestic hot water, and process work.

You can get the most out of your compressor plant only by choosing the correct machines. I-R engineers will help you select the type, the size, and the drive that are most suitable for your particular installation.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

1-396

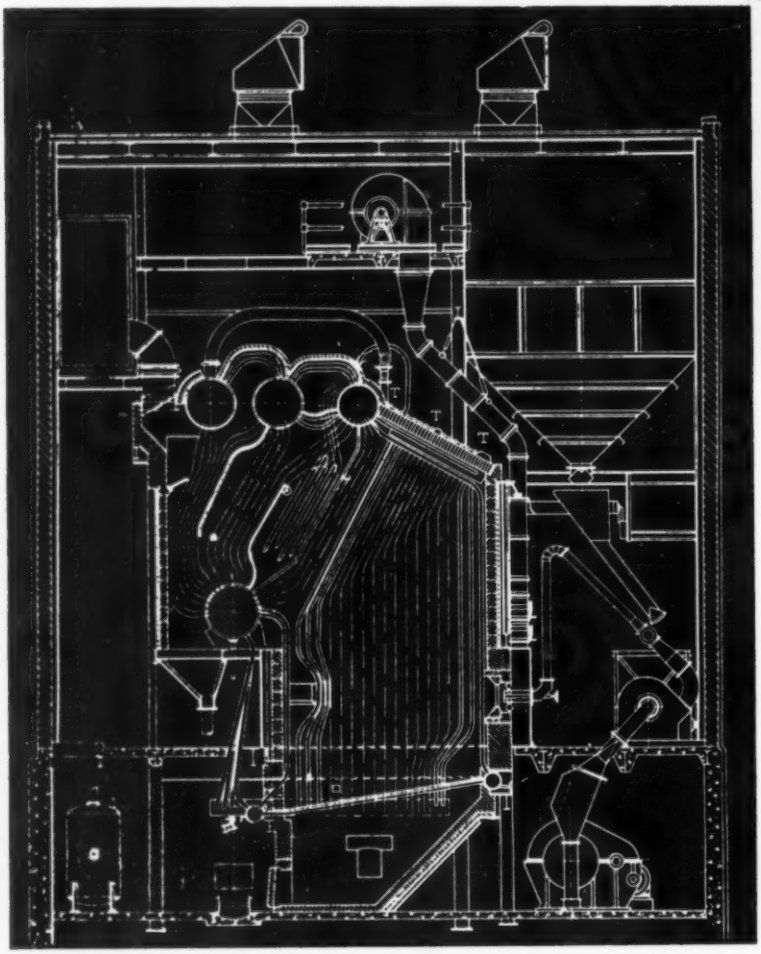
COMPRESSORS • TURBO BLOWERS • ROCK DRILLS • AIR TOOLS • OIL AND GAS ENGINES • CONDENSERS • CENTRIFUGAL PUMPS

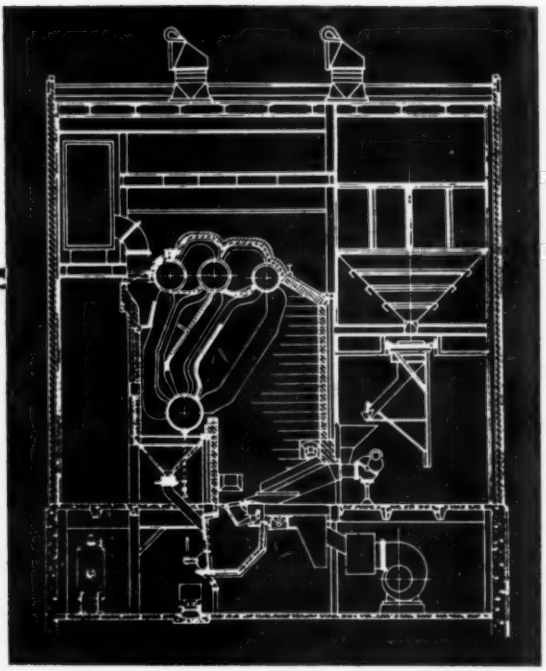
$20,000 a year SAVED in COAL COSTS

By Converting to Pulverized Fuel

•

KENNEDY *Air-Swept* TUBE MILL
makes this economy possible through ability to burn low grade fuel . . .





BEFORE (ABOVE)

Showing one of two boilers in Ohio Municipal Power Plant before conversion. The boilers together carried an average load of 35,000 lbs. per hour. The fuel used was the best Imported West Virginia Coal.

•

AFTER (LEFT)

The same boiler after conversion and installation of *Kennedy Air Swept Tube Mill and Water Walls.* The capacity of each boiler was increased 33% to 47,000 lbs. per hour, permitting the load to be carried by one boiler with the other held for stand by. The fuel now burned is Ohio Strip Mine Coal costing $1.50 less per ton than formerly. Boiler efficiency is now 80%. Saving: $20,000 a year in coal costs.

YOU, TOO, CAN MAKE SAVINGS

Now is the time to start rehabilitating your boiler plant. All signs indicate that the coals available in the future will be lower in grade and more difficult to burn. This prospect emphasizes the necessity for converting existing plants to burn lower grade coals efficiently. Kennedy-Van Saun is prepared to help you meet this new condition and offer valuable suggestions for solving the problems that lie immediately ahead. You are invited to consult freely with our engineers on any plans you are making for plant installation or rehabilitation.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVE., NEW YORK 16, N. Y.
Factories: Danville, Pa., Canada, England, Australia

THIS BOOK TELLS YOU HOW TO DO IT — MAIL COUPON

Kennedy-Van Saun Mfg. & Engr. Corp., 2 Park Ave., New York 16, N. Y.

Kindly send me Bulletin No. 12 explaining how lower grade coals can be burned efficiently;

Name ..... Position .....

Company .....

Address P-5-44

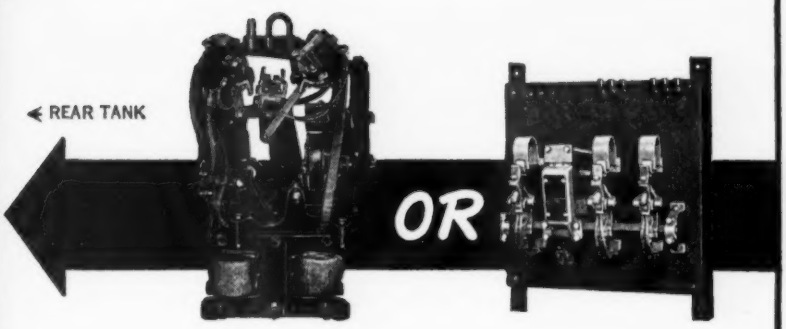
EC&M {OIL-IMMERSED / CUBICLE-TYPE} STARTERS

FOR 220-550 VOLT SYNCHRONOUS MOTORS

Companion Line to Bulletin 1076-A, Air-Break Starters

LINE AND FIELD AMMETERS
DOOR TO OVERLOAD RELAY COMPARTMENT AT RIGHT
EXCITER FIELD RHEOSTAT
FIELD-PANEL AND DISCHARGE RESISTORS MOUNTED IN THIS COMPARTMENT

STANDARD STARTER



At left above, is compensator-mechanism for reduced voltage starting and at right is contactor for full voltage starting. Depending upon the type of starter selected, one or the other of the above is mounted in oil tank at rear.

COMPLETE UNITS IN *Every* RESPECT

ELECTRONIC RELAY APPLIES D-C TO FIELD AUTOMATICALLY

View shows automatic field-panel which is mounted in lower compartment of front cubicle and is of tilting-panel type. Easily adjustable, electronic-type relay applies direct current to motor field to pull motor into synchronism automatically.

WITH all internal wiring complete and totally enclosed (NEMA Type I enclosure), these unit-type starters may be mounted out in the plant alongside the motors they control or in a separate control room.

Arranged for two or three phase service. Maximum ratings—(reduced voltage) 150 H.P., 220 volts and 300 H.P., 440 and 550 volts—(full voltage) 400 H.P., 220 volts and 800 H.P., 440 and 550 volts.

Standard features include equipment as illustrated above. Optional features include other NEMA Types of enclosures; voltmeter and other instruments; indicating light; field-removal and automatic resynchronization should motor pull out-of-step, etc.

Complete details given in Bulletin 1075-A. Ask for your copy to-day.

EC&M COMPLETELY AUTOMATIC — SYNCHRONOUS STARTERS

THE ELECTRIC CONTROLLER & MFG. CO., Cleveland 4, Ohio

Time Proved Performance

FOR over twenty-five years "Carbofrax" brick in boiler furnace settings have been giving the following results:—

1. Continuity of operation assured.
With the long life secured from "Carbofrax" frequent shutdowns due to lining failures are eliminated. Interruptions to production are thereby reduced.

2. Steaming capacity increased.
Since clinker does not build out on the hard, dense face of "Carbofrax" brick the effective grate area is maintained and steam production is kept at a maximum.

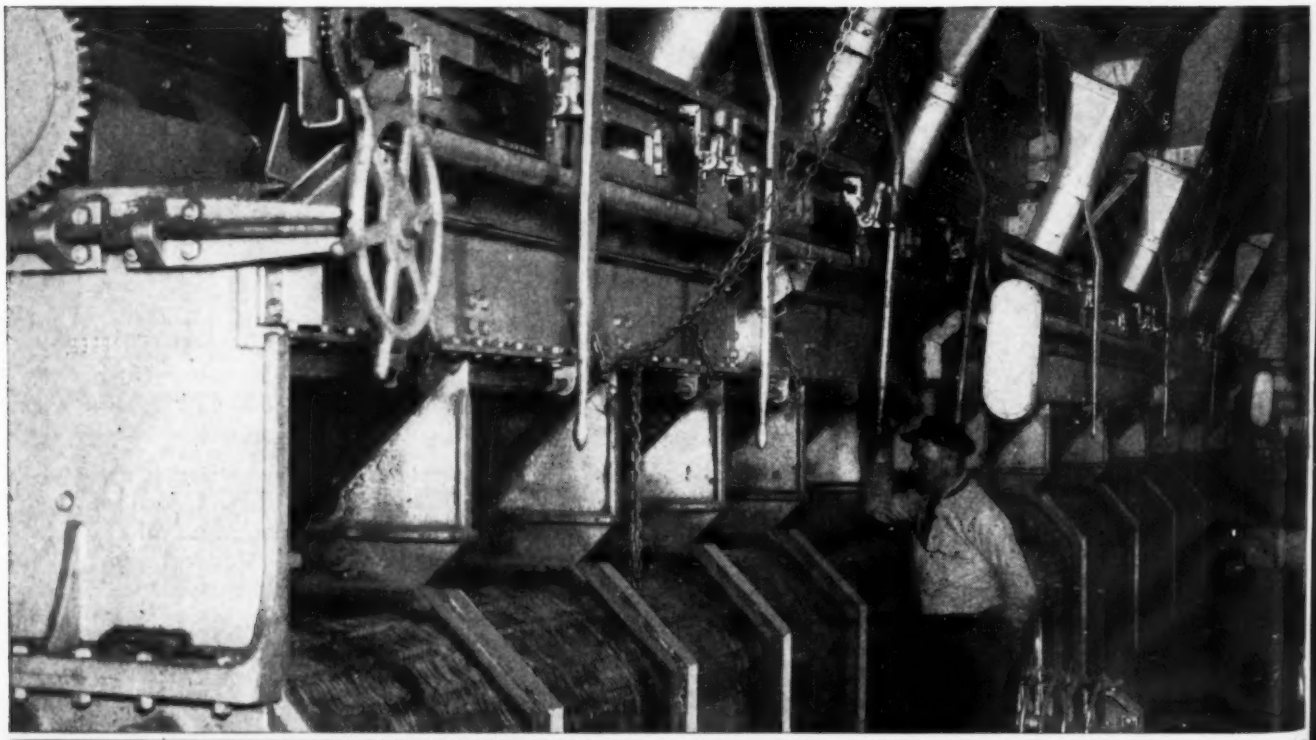
3. Boiler efficiency improved.
Because "Carbofrax" eliminates heavy clinker formations combustion conditions are vastly improved and greater efficiency results.

4. Refractory and maintenance costs reduced. "Carbofrax" brick in the fuel bed section do not burn or cut back. Hence, a good foundation for the upper wall is assured.

Now used in several thousand installations these "Carbofrax" brick are available to all boiler furnace operators. The Carborundum Company, Refractory Division, Perth Amboy, N. J.

REFRACTORY CARBORUNDUM PRODUCTS

District Sales Branches: Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh. Distributors: McConnell Sales and Engineering Corporation, Birmingham, Ala.; Christy Firebrick Company, St. Louis, Mo.; Harrison & Company, Salt Lake City, Utah; Pacific Abrasive Supply Company, Los Angeles, San Francisco, Calif.; Denver Fire Clay Company, El Paso, Texas; Smith-Sharpe Company, Minneapolis, Minn.



Super Refractories by CARBORUNDUM TRADE-MARK

(Carborundum and Carbofrax are registered trade marks of and indicate manufacture by The Carborundum Company)

EXAMPLE OF *Service*:

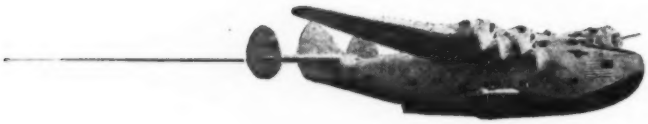
A chain of 150 motion picture houses was having consistent trouble with its power equipment. Many experts tried to correct it and failed... then one of our Cities Service Lubrication Engineers tackled the problem. With the exclusive Cities Service *Industrial Heat Prover* he analyzed combustion... made necessary adjustments. In the two years since, these plants have shown greater efficiency, lower operating costs.

More and more, it's <u>service</u> that counts...

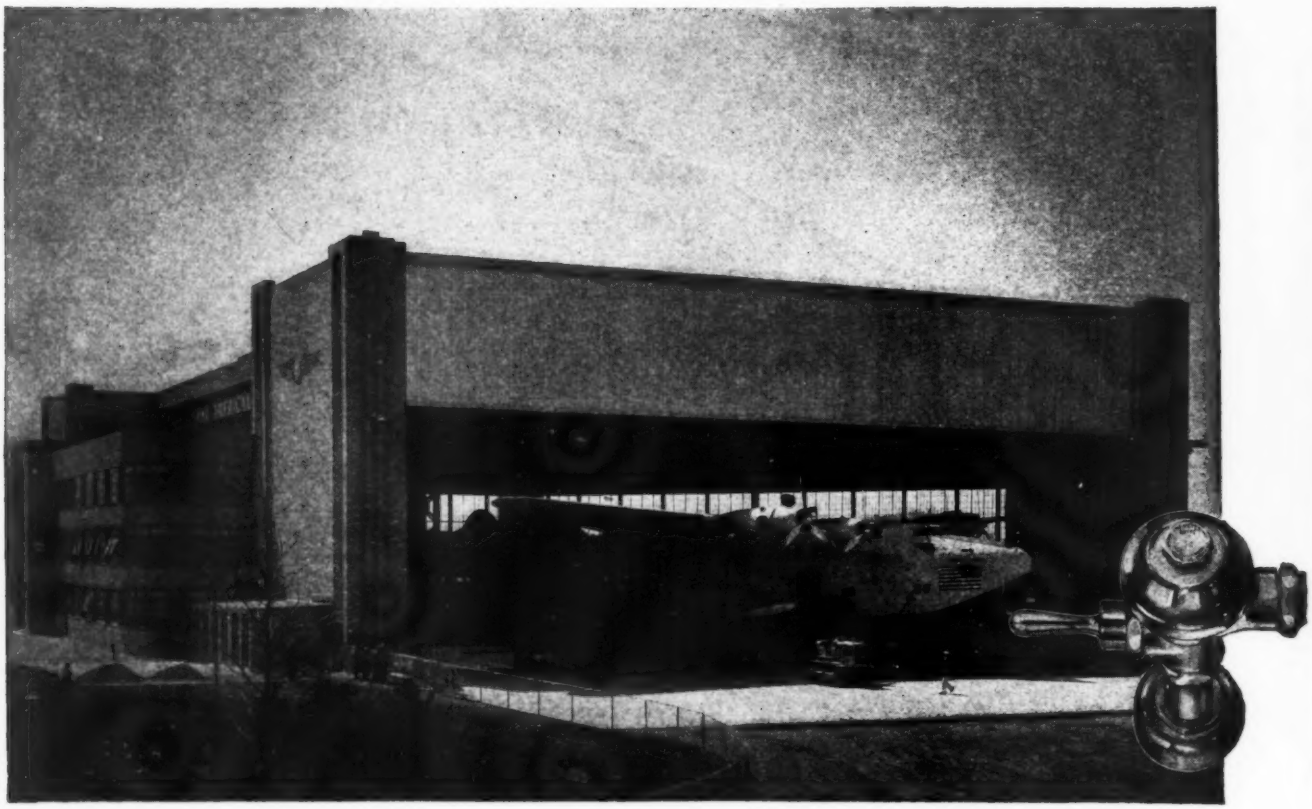
and *Cities Service* means <u>good</u> <u>service</u>!

CITIES SERVICE OILS
ONCE-ALWAYS

CITIES SERVICE OIL COMPANY
ARKANSAS FUEL OIL COMPANY



PAN AMERICAN AIRWAYS— SLOAN EQUIPPED



Sloan Flush Valves are installed in the Pan American World Airways' North Beach hangar at La Guardia Field and in their new office and hangar building at Miami—as well as in many of the buildings at Pan American's far flung overseas bases. Airway operators have long since learned there can be no compromise with safety or quality. Hence, their choice of Sloan Flush Valves—the brand which sells more than all other makes combined.

SLOAN VALVE COMPANY

4300 WEST LAKE STREET · CHICAGO, ILLINOIS

ARMY (E) NAVY

SLOAN *Flush* VALVES

Wright

makes your ceiling your freight clearing yard . . .

For routing and distributing materials, **WRIGHT** Hoists and Cranes convert your plant ceiling into a clearing yard—where vertical and horizontal material-handling takes place speedily, safely and economically. **WRIGHT** Improved High Speed Hoists, **WRIGHT** *Speedway* Electric Hoists and **WRIGHT** Cranes turn idle ceilings into busy, productive areas and save time and money.

Whatever your handling problem may be, **WRIGHT** engineers and distributors are qualified and capable to give you helpful assistance. Look under "**HOISTS**" in your classified telephone directory for the name of your local **WRIGHT** distributor. He is a good man to consult about better material-handling methods in your plant.

WRIGHT MANUFACTURING DIVISION
York, Pa., Chicago, Denver, Los Angeles, San Francisco, Portland, New York

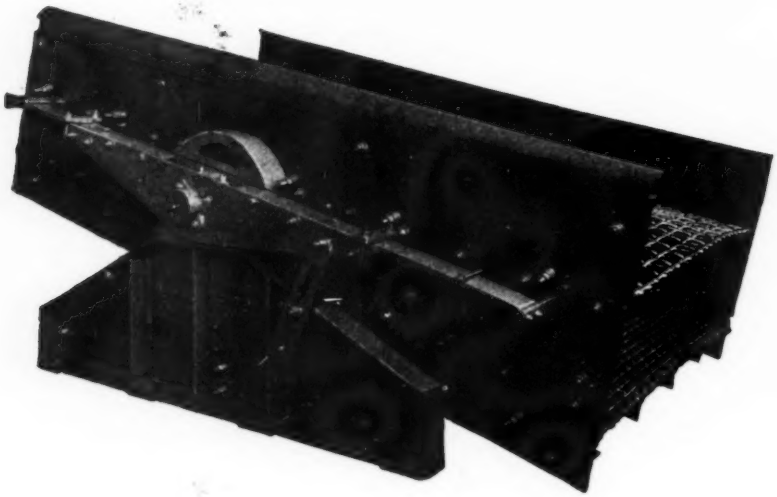
AMERICAN CHAIN & CABLE COMPANY, INC.
BRIDGEPORT • CONNECTICUT

ARMY E NAVY
FLYING OVER THE WRIGHT HOIST PLANT

ACCO
In Business for Your Safety

WRIGHT
Improved
High Speed
HOISTS

Because Robins Screens are Engineered



THEY SET RECORDS LIKE THIS • • •

EVERY Robins Vibrating Screen is engineered for the specific job it is to perform. As a result, it is able to serve not only efficiently, but enduringly . . . and economically.

A typical instance was told to us recently. Twelve years ago, a sand and gravel plant purchased a Robins Gyrex Screen. That Screen was hung out in the open air—suspended in the members of a truss . . . exposed to the elements constantly. Every bit of material entering that plant passes over the Gyrex for rinsing.

In all these years, not a penny has been spent on maintenance or repair of that Gyrex—until recently, when the V-ropes of the drive started to fray. Even then, no extra cost was involved; they merely put on the spares which were bought with the Screen those twelve long years ago.

Robins makes Vibrating Screens of various types for all sizing, scalping and dewatering purposes. All are engineered individually for each particular application . . . given the correct speed, stroke, pitch and number of decks required for the kind, weight, mass, flow and quantity of bulk material to be sized and handled. For detailed recommendations, without cost or obligation, address Dept. P-5.

ENGINEERS • MANUFACTURERS • ERECTORS

ROBINS CONVEYORS INCORPORATED
Founded in 1896 as Robins Conveying Belt Co.
PASSAIC • NEW JERSEY

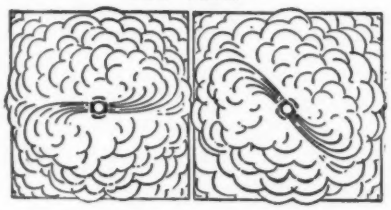
MATERIALS HANDLING MACHINERY

ROBINS *makes:* BELT CONVEYORS • COAL AND ORE BRIDGES • BUCKET ELEVATORS • CAR AND BARGE HAULS • CAR DUMPERS • CAR RETARDERS • CASTINGS • CHUTES • CONVEYOR IDLERS AND PULLEYS • CRUSHERS • FEEDERS • FOUNDRY SHAKEOUTS • GATES • GEARS • GRAB BUCKETS • PIVOTED BUCKET CONVEYORS • VIBRATING SCREENS • SCREEN CLOTH • SELF-UNLOADING BOAT MECHANISMS • SKIP HOISTS • STORAGE AND RECLAIMING MACHINES AND SYSTEMS • TAKEUPS • LOADING AND UNLOADING TOWERS • TRIPPERS • WEIGH LARRIES • WINCHES • WINDLASSES

FOR MATERIAL AID IN MATERIALS HANDLING . . . . . **It's ROBINS**

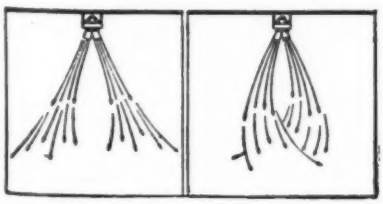
"HEATING NEWARK BAY"

TOP VIEW



SWEEPING AIR FLOW

ELEVATION



AIR BLANKET

That's the phrase the Northern Air Conditioning Corporation of Newark, N. J., used to describe an installation of Wing Revolving Unit Heaters they made recently.

The problem put up to them was that of providing a working temperature of 55° in a boat shed the "floor" of which was largely the surface of Newark Bay. Because of the heat absorbing qualities of this unusual "floor" it was decided to lay a protecting blanket of warm air over the working area, much as the Navy lays a smoke screen over the water to protect naval operations from prying eyes.

The largest size Wing Revolving Unit Heater was installed and is now in successful operation, laying a continuous blanket of warmed air above the entire working area, with minimum temperature differential and controlled air flow at a level of 5 feet above tidal water.

This is a remarkable example of the way in which *controlled* heating can be maintained by means of the *Revolving* Unit Heater. The wind around this installation is seldom below 20 miles per hour and the mercury shrinks well to the zero mark, yet the continuous blanket of warm air from the revolving discharges of the Wing heater keeps the working area at a comfortable temperature. It is obvious that no other form of heating could accomplish these results.

You may not have a heating problem as unique as "heating Newark Bay" but it will pay you to investigate Wing Revolving Unit Heaters.

L. J. Wing Mfg. Co.

50 Seventh Ave., New York 11, N. Y.
Factories: Newark, N. J., Montreal, Canada

POWER TO WAGE WAR AND TO SERVE PEACE

FROM the very beginning, GM Diesels have been tested in the crucible of war. They power tanks, heavy gun tractors and bulldozers; submarines and subchasers; invasion boats and lighters. And everywhere, always, these weapons are proving worthy of the fine fighting men who are using them.

That is because GM Diesel operation is based on simple and sound mechanical principles. GM Diesel construction is exceptionally strong and uniformly precise—the way General Motors always builds.

When normal life and living are resumed, GM Diesels will be as ready to step back into private life and resume service in peace as they were to go to war. And you will find them as capable of sure, reliable, low-cost performance on the toughest jobs at home as they are on fighting fronts the world over.

America's farms are going to need GM Diesel power for their tractors. This sure, reliable, low-cost source of power will go far toward solving some of the farmer's most vexing problems. And not the least of these problems is to get more work done, faster and at lower cost in labor and mechanical power. GM Diesels will help.

GM
GENERAL MOTORS
DIESEL POWER

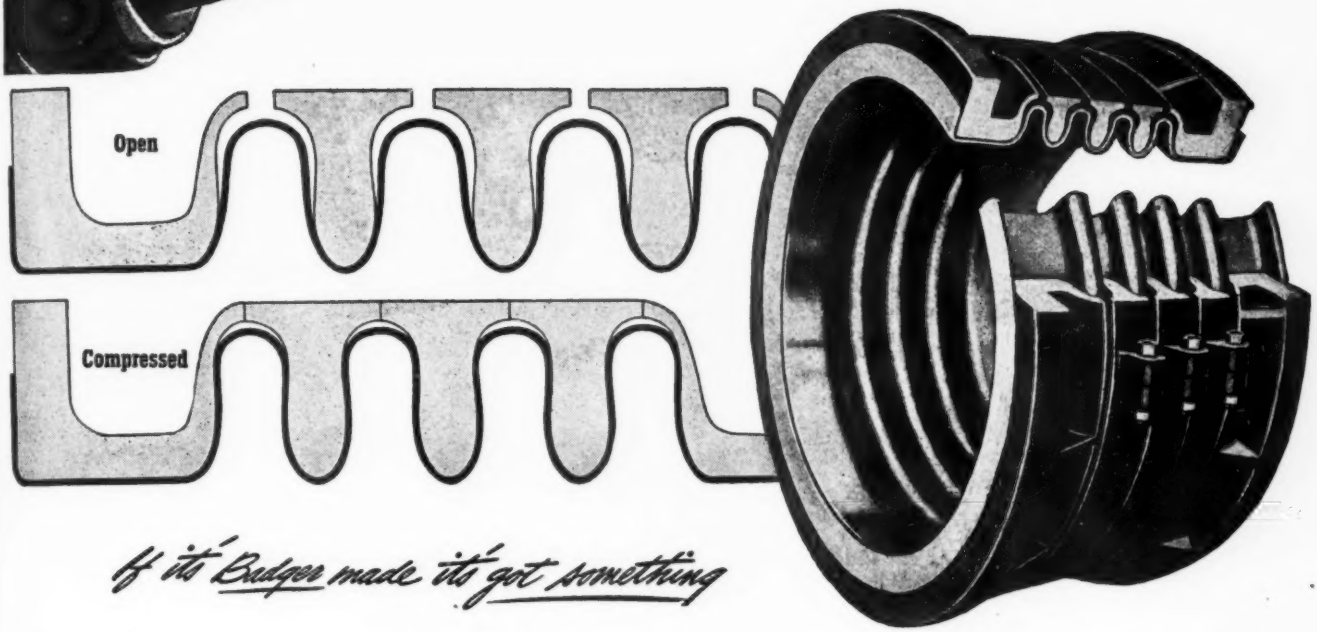
ENGINES...15 to 250 H.P... **DETROIT DIESEL ENGINE DIVISION,** Detroit, Mich.

ENGINES...150 to 2000 H.P.....CLEVELAND DIESEL ENGINE DIVISION, Cleveland, Ohio

LOCOMOTIVES.....ELECTRO-MOTIVE DIVISION, La Grange, Ill.

THUS FAR AND NO FARTHER

. . . say the equalizing rings in directing the flexing of this expansion joint



If it's Badger made it's got something

VESTED with authority, the officer's hand says "Stop!" . . . Traffic toes the "Limit" mark—or swings to the right or left as directed.

Pipe-line stresses due to temperatures and pressures are dealt with in similar fashion in Badger Self-equalizing Corrugated Expansion Joints:

First, the ALL-CURVE corrugations (exclusive in Badger Joints) absorb normal stresses progressively and evenly—having no straight sides, angles or "junctions" to encourage localizing of stresses.

Secondly, as stresses go higher the Badger ALL-CURVE equalizing rings become "officers in charge." They step in and prevent "congestion" by *directing the flexing movement*. They make sure there is no "piling up" of stresses in any one section of a corrugation—that they are distributed uniformly among *all* the corrugations of the joint.

DIRECTED FLEXING in Badger Self-equalizing Corrugated Expansion Joints is achieved through design that co-ordinates the actions of Badger ALL-CURVE corrugations and Badger ALL-CURVE equalizing rings. . . . The contacting contours of the rings match those of the corrugations. *There are no other expansion joints with this unique feature for ideal functioning and doubly assured dependability.*

Simply make sure that each Badger Self-equalizing Joint has a sufficient number of corrugations to provide a safe margin of traverse for its task, and throughout its long serviceable life you'll never have any trouble from "buckling," "springing" or other overstrains in pipe-line or equipment.

PACKLESS AND COMPACT—Being specially formed from a single piece of tubing, these definitely superior joints need *no packing*—and, consequently, no packing maintenance. (Manhole and tunneling expense is thus saved in underground installations.) Taking up no more room than a comparable flanged fitting, Badger Joints waste no space.

• • •

• Made in Copper for normal pressures and temperatures; in Stainless Steel for higher pressures and temperatures—and where corrosion is a problem. Single and multiple corrugations—to take care of traverses ranging from a fraction of an inch upward.

Also made in *Non-equalizing* type for pressures and traverses that do not require the added protection of equalizing rings. *FREE BULLETINS: No. 100 on Self-equalizing: No. 200 on Non-equalizing.*

E. B. BADGER & SONS CO., 75 PITTS STREET, BOSTON, MASS.

AGENTS IN PRINCIPAL CITIES

Badger

PACKLESS CORRUGATED EXPANSION JOINTS

CHASE ANTIMONIAL ADMIRALTY*

Condenser tube service records reveal that Chase Antimonial Admiralty is extraordinarily resistant to dezincification. In fact, not one failure from this cause has been reported — and there are millions of pounds of Chase Antimonial Admiralty tubes in use, some of them since 1935.

Yet the longer service life you get from Antimonial Admiralty adds nothing to the initial cost of the tubes. You pay no more for Chase Antimonial Admiralty than for plain Admiralty.

REMEMBER these three points about Chase Antimonial Admiralty. It is (1) extraordinarily resistant to dezincification; (2) virtually immune to stress-free intercrystalline corrosion; (3) costs no more than plain Admiralty.

Just phone the nearest Chase Sales Service Office for full information on Antimonial Admiralty.

*U. S. Pat. No. 2,061,931

CHASE

SPECIAL STOCKS OF ANTIMONIAL ADMIRALTY at HOUSTON LOS ANGELES NEW ORLEANS SAN FRANCISCO TULSA

CHASE BRASS & COPPER CO.

—Incorporated—
Waterbury, Connecticut
A SUBSIDIARY OF KENNECOTT COPPER CORPORATION

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON INDIANAPOLIS† KANSAS CITY, MO.† LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON†

† Indicates Sales Office Only

This is the Chase Network—handiest way to buy brass

HOW TO MAKE STEAM COSTS "STAY LICKED"

IT'S ONE THING to win skirmishes in the endless war against high steam costs. It's quite another to find the winning tactics that rout fuel waste and high costs — that make them *stay licked.*

That's exactly how numerous executives—*shrewd strategists*—are winning on the boiler-room front: by utilizing Automatic Combustion Control. Hays Combustion Control *electrically* operated, measures every combustion factor, records every variation, instantly corrects those variations. It's simple, error-proof — AUTOMATIC.

With plant capacities straining to meet war materiel needs, with new equipment barred, with man-power restricted, many plants have found Hays Combustion Control ideal and practical. It saves man-hours, works tirelessly, 24 hours a day . . . gets the utmost efficiency—cuts operating costs.

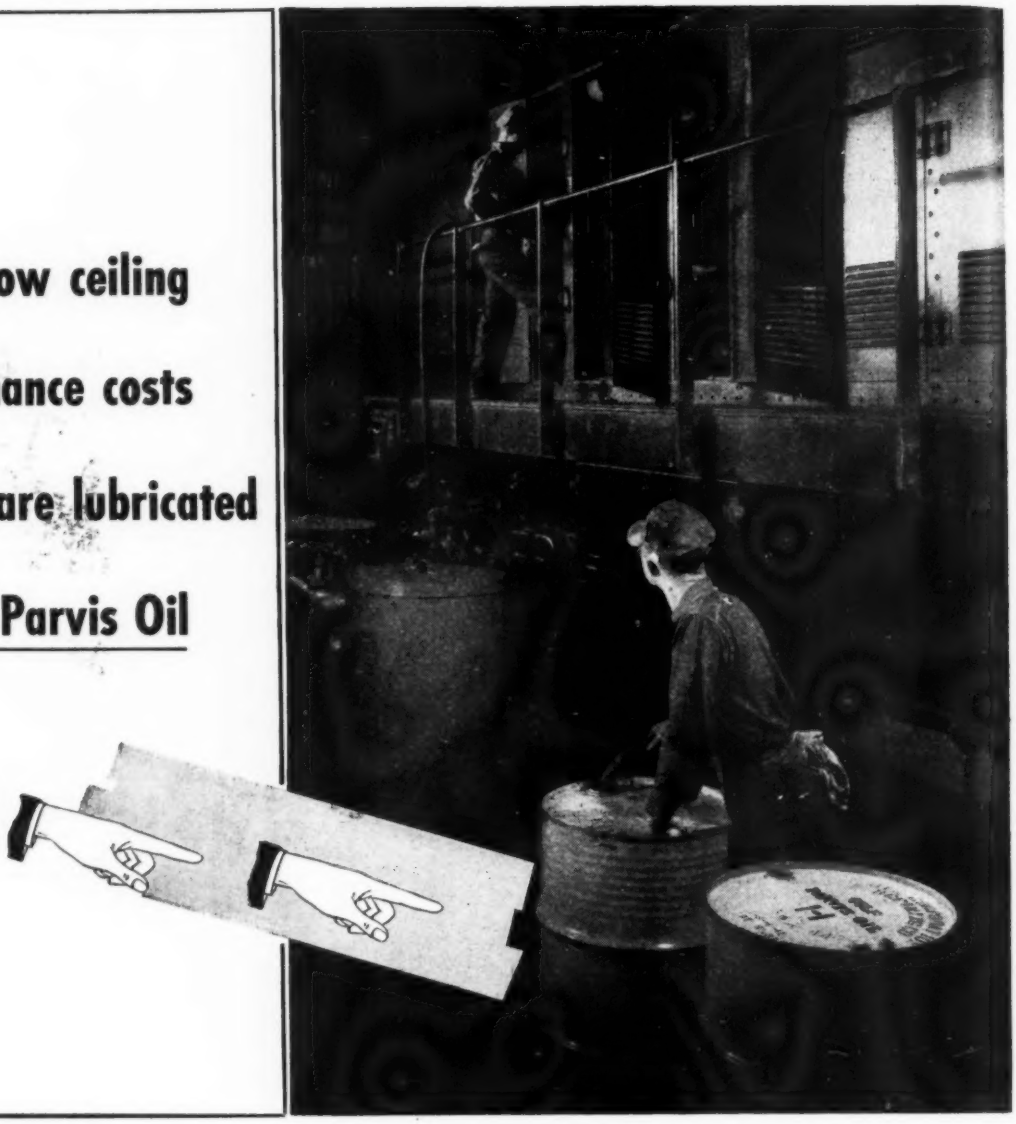
Smart tactics: send now for the Hays Combustion Control Catalog full of useful steam-power data, "must" literature for industrial strategists.

THE MODERN SYSTEM *It's Electrical*

HAYS *Automatic* COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, IND.

There's a low ceiling on maintenance costs when Diesels are lubricated with Gulf Parvis Oil



With Gulf Parvis Oil, a prominent railroad cut maintenance costs of Diesel switching locomotives 18%, and increased availability 8%. The photo above shows one of these units being serviced with fuel and lubricating oil.

Maintenance costs usually tell the story of lubrication efficiency — and Diesel maintenance costs hit new lows with Gulf Parvis Oil in service.

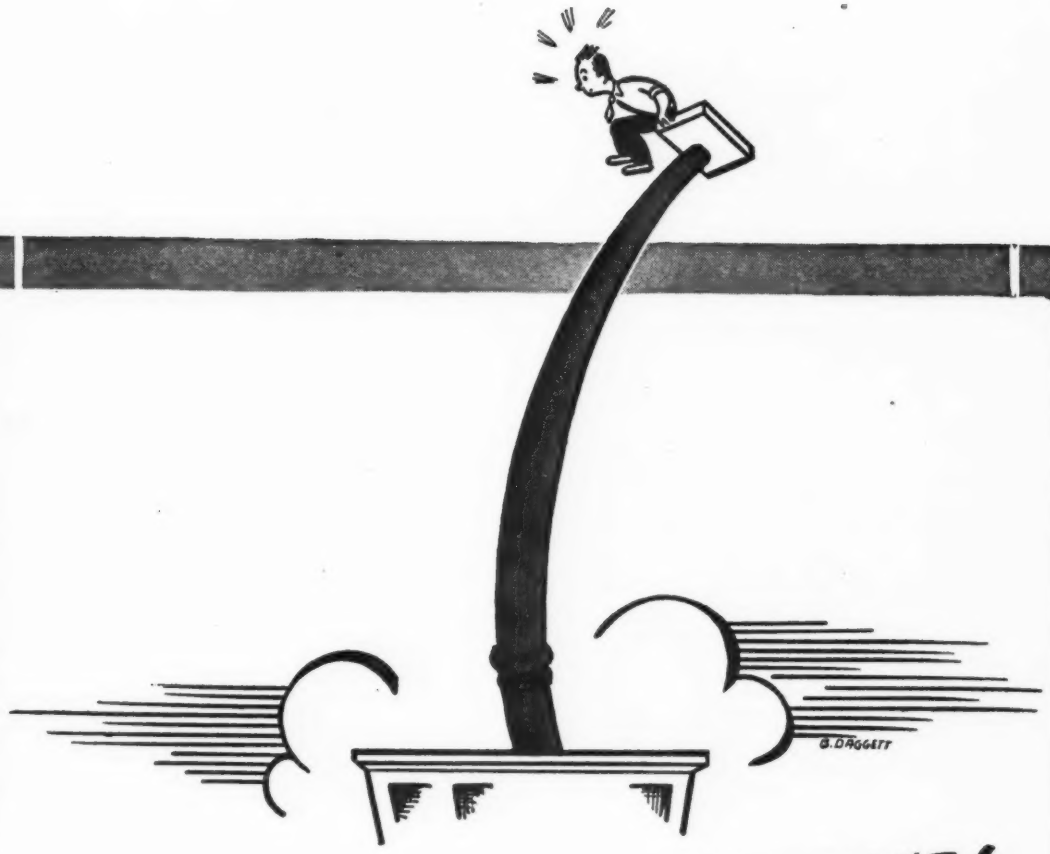
Especially manufactured for improved lubrication of Diesel engines, Gulf Parvis Oil provides greater protection for cylinders, pistons, bearings, and other hard-to-replace parts under today's peak-load and over-load operating conditions. Gulf Parvis Oil offers you *proven performance and long life!*

For better lubrication of your Diesels, call in a Gulf Service Engineer and ask him to recommend the proper type and grade of Gulf Parvis Oil to fit your particular requirements. His thorough training and broad experience with all types of Diesel engines is your assurance of sound and helpful recommendations. Write, wire, or phone your nearest Gulf office today.

GULF INDUSTRIAL LUBRICATION

BACK THE ATTACK...
BUY MORE WAR BONDS!

GULF OIL CORPORATION · GULF REFINING COMPANY · GULF BUILDING, PITTSBURGH 30, PA.



PIPE SHOULD BE *DEPENDABLE!*

There may be times when the welfare of an industry---or an entire community---is dependent upon our product.

That's why Flori piping must conform to rigid inspection---that's why Flori pipes are fabricated and tested by qualified workmen according to coded procedure.

FLORI PIPING

THE FLORI PIPE COMPANY, ST. LOUIS — CHICAGO

How to save Dollars in Boiler Water Conditioning

Follow the Elgin Straight-Line Route to END RESULTS

How many of the frills and gadgets that are finding their way into water conditioning systems today are really justified? True, they may accomplish the required results, but do they give you any *extra* results to justify the *extra* investment and maintenance costs? And what about the obsolescence factor that always goes with innovations?

In the final analysis, the three major results you seek are clean, scale-free boilers; dry steam; freedom from corrosion and embrittlement. So, obviously, the smart and business-like thing to do is to adopt the method or system that will achieve these results most efficiently and most economically.

This is precisely the approach followed by experienced Elgin Engineers in providing effective, economical water conditioning. Their analysis of your individual requirements may suggest low-cost individually formulated chemical treatment with or without the Elgin Deconcentrator for sludge removal — or the economical zeolite water softener with post treatment. Modernization of your present equipment may be the best answer — particularly if you are using a zeolite water softener, in which case its capacity can be increased as much as 44% by means of the Elgin "Double-Check" type manifold system and Elgin Zeolite.

But whatever our recommendation, you can be sure it will be that system which most economically provides those *final* objectives: clean boilers, dry steam and freedom from corrosion and embrittlement of boiler metal. An elaborate system will not be recommended unless thoroughly justified by sound analysis of investment and operating costs.

Yes, despite the fact that Elgin is in a position to give you any authoritative method or equipment, the Elgin policy is to follow the straight line to practical results at minimum cost. One of our district engineers would like to show you exactly what we mean in terms of your specific needs. No obligation whatever is involved.

ELGIN SOFTENER CORPORATION
130 North Grove Avenue, Elgin, Illinois

ELGIN
ECONOMICAL
WATER CONDITIONING

THE COMPLETE ELGIN LINE

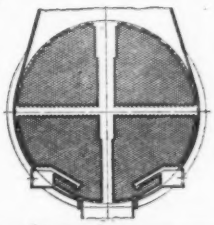
Boiler Water Treating and Purifying Systems • Feedwater Treatment • Deconcentrators • Heat Exchangers • Water Softeners Filters and Purifiers • Iron Removal Equipment • Aerators • Water Treating Chemicals • Chemical Feeders • Scale and Corrosion Inhibitors • Sample Coolers • Water Testing Equipment • Zeolites

28 Years of C. H. Wheeler DUAL BANK CONDENSERS

KEEP PACE WITH IMPROVEMENTS IN TURBINE DESIGN

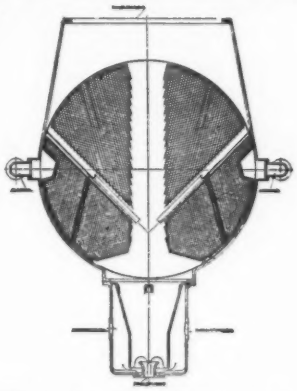
As the Steam Turbine was developed for higher vacuum, C. H. Wheeler Condensers kept apace of the same trend.

1916 **THE FIRST C. H. WHEELER CONDENSER** with which the steam ejector type air pumps were used is shown by this actual installation tube sheet.



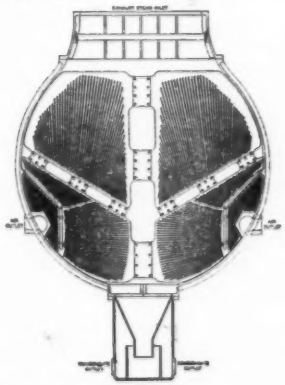
Result: Condensate temperatures within 5° of temperatures corresponding to vacuum.

1923 **IMPROVEMENT:** Wider steam lane and hotter condensate—shown in literature published at that time.



Result: This produced condensate temperature corresponding to temperature of vacuum and the oxygen content was less than 0.03 cc per litre.

1929 **FURTHER IMPROVEMENT:** More open area for entering steam—illustrated in literature published at that time.

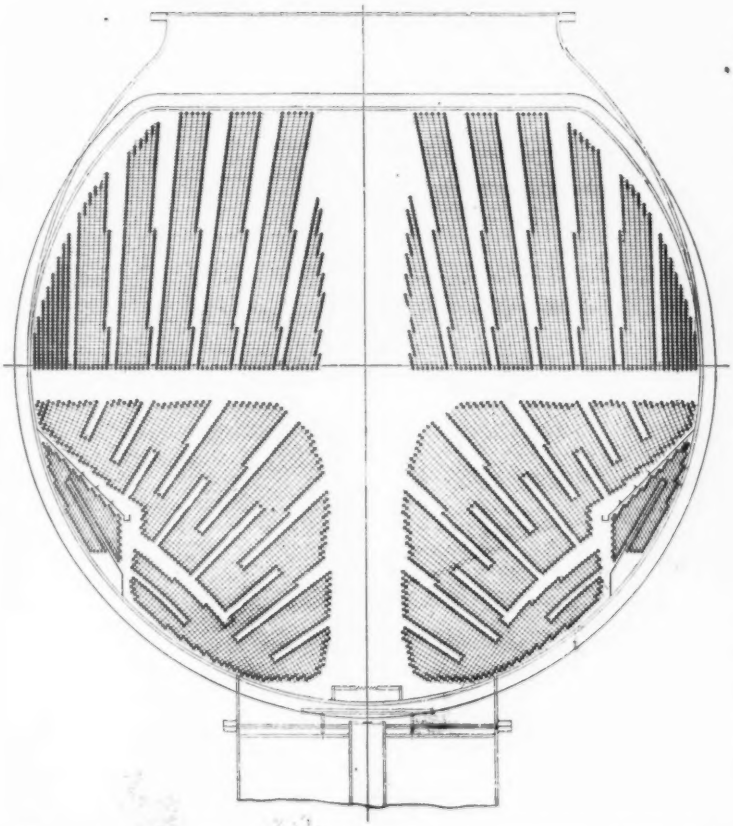


Result: Less pressure drop.

1944

ARMY E NAVY

NOW—Additional steam lanes give deeper penetration for the entering steam!



It is evident from the illustrations that the C. H. Wheeler Manufacturing Company has pioneered the development of this highly efficient Dual Bank Condenser.

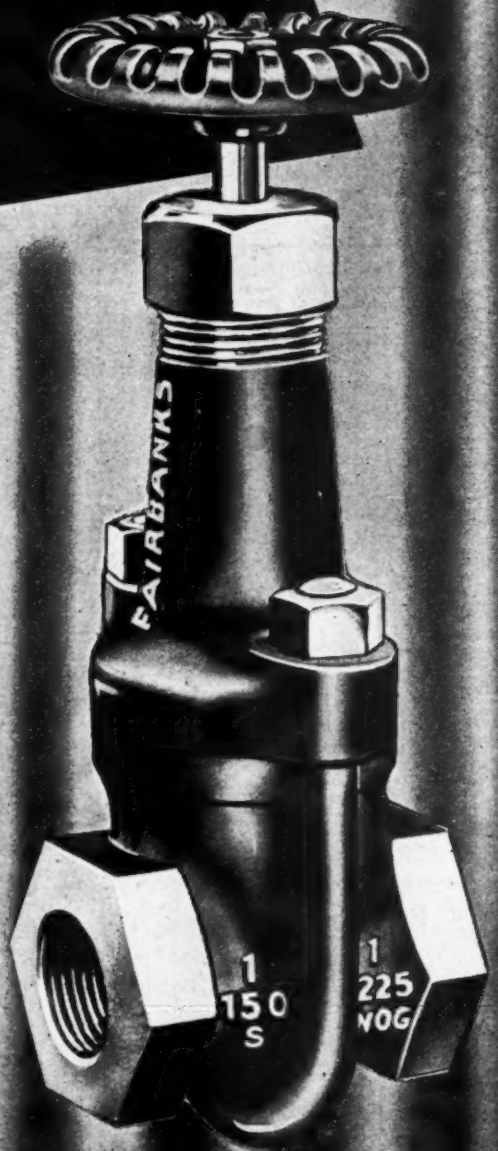
PRODUCTS: Surface Condensers • Steam Jet Ejectors • Cooling Towers • Deck Machinery

C. H. WHEELER MANUFACTURING CO.

19th ST. and LEHIGH AVE., PHILADELPHIA, PA. *of Philadelphia*

FAIRBANKS VALVES

Cost Less to Maintain



Fairbanks improved U-Bolt all-iron and bronze-mounted gate valves meet the demand for an extremely rugged valve at low cost.

They can be taken apart for inspection and cleaning by removing only two nuts. Large, accurately machined counter-bore in body prevents distortion when tightening nuts.

Reversible double-taper, knife-edge wedge cuts through heavy fluids and sediment. When fully open wedge is entirely lifted from the line of flow.

Relief slots insure drainage back into body and prevent clogging or freezing.

Write for Catalog 42 and name of nearest distributor.

True to a Quality Tradition

THE FAIRBANKS CO.
393 Lafayette St., New York 3, N. Y.
Boston, Mass. Pittsburgh, Pa.

15 HENDY FEATURES

In the turbine—

1. Economical water rate per kwh.
2. Rigid spindles with discs having large hub sections form the backbone of the turbine structure and assure greater strength.
3. Step cut labyrinth diaphragm seals.
4. Steel Rateau nozzle discs with welded-in, rolled stainless steel nozzle blades and spacers.
5. Governing system that uses anti-friction bearings and is without stuffing boxes or soft packing.
6. Smooth, compact design without sacrifice of accessibility.

In the reduction gear—

7. Fabricated steel gear case, smoothly finished — no sharp corners or edges.
8. Rigidity combined with light weight.
9. External piping reduced to a minimum.

In the generator—

10. Rolled steel-plate field yoke of split type with halves bolted together.
11. Shock-proof, solid construction, giving greatest safety under adverse conditions.
12. Liberally dimensioned, providing capacity for emergency overloads.
13. High efficiency through careful design.
14. Self-aligning sleeve type bearing mounted in spherical seat insuring simple alignment of shaft.
15. Sixty-six years of generator building experience.

New.. POWER for a more electrified America

Built to the rigid requirements of U.S. Navy and Maritime Commission specifications for war service today, this Hendy Turbo-generator plant forecasts the standards for postwar electric generating equipment.

In developing its rugged, compact design, Hendy engineers swept the boards of old ideas—the result is a unit of sound reliability and long service life.

Construction features normally found only in larger turbo-generators are in these new Hendy power plants. These features insure larger factors of strength and safety, more economical operation and higher over-all efficiency.

Hendy turbo-generating plants are designed in a range of 250 to 750 kw permitting their use in a wide variety of marine and industrial service. Submission of your specification requirements is invited.

JOSHUA HENDY Division

JOSHUA HENDY IRON WORKS

SUNNYVALE, CALIFORNIA

EST. 1886 HENDY

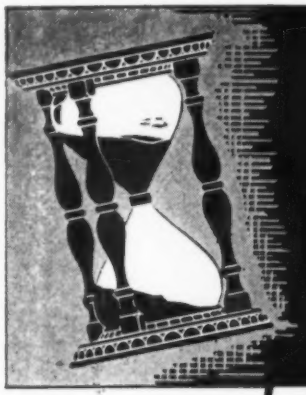
BRANCH OFFICES: Boston • Buffalo • Chicago • Cincinnati • Cleveland • Detroit • New York • Philadelphia • Pittsburgh • San Francisco • St. Louis • Washington • Los Angeles

TURBO-GENERATORS

REDUCTION GEARS

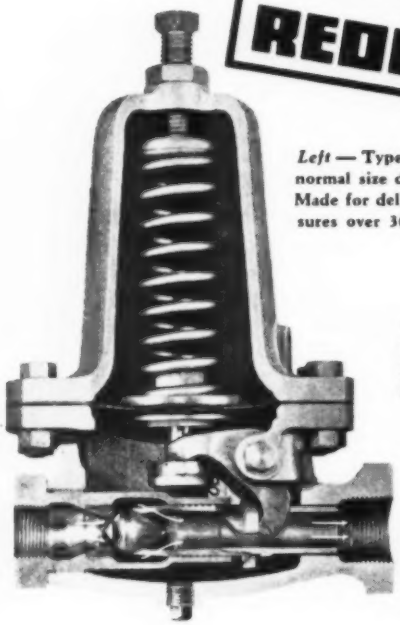
STEAM TURBINES

DIESEL ENGINES

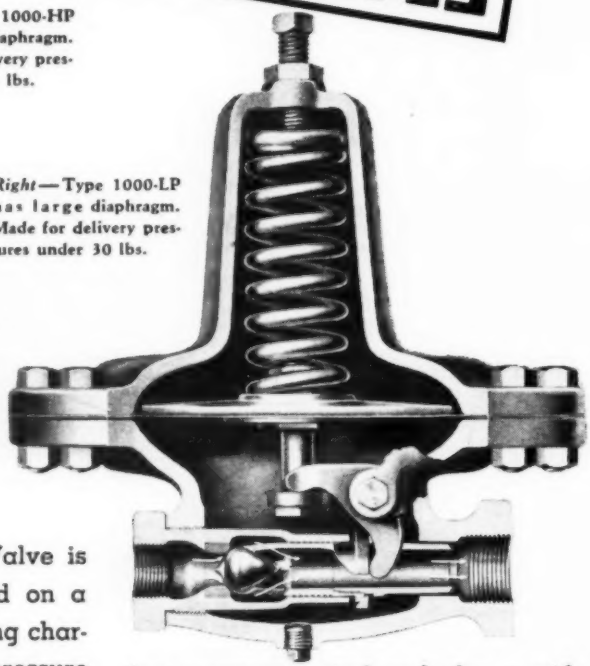


DAYS of able performance grow into YEARS

CASH STANDARD *Streamlined* PRESSURE REDUCING VALVES TYPE 1000



Left — Type 1000-HP normal size diaphragm. Made for delivery pressures over 30 lbs.



Right — Type 1000-LP has large diaphragm. Made for delivery pressures under 30 lbs.

The "1000" STREAMLINED Valve is a performer of top rank, rated on a basis of capacity — tight closing characteristics and close delivery pressure control.

The straight line flow promotes greater capacity — the "1000" is single seated and its valve makes line contact with its seat ring which accounts for its tight closing characteristics — the unusually long diaphragm spring insures sensitive pressure control and also a wide range of adjustment.

The benefits from this kind of top performance include: — practically zero in maintenance — elimination of failures —speedier production—smooth operation and no spoilage.

•

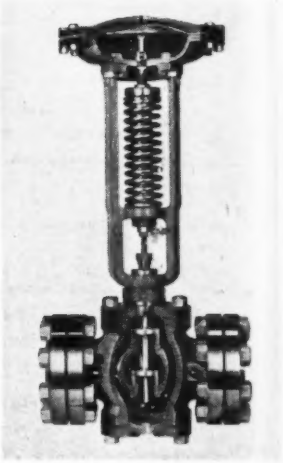
Write for Bulletin "1000" for full details.

•

CASH STANDARD CONTROLS.. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

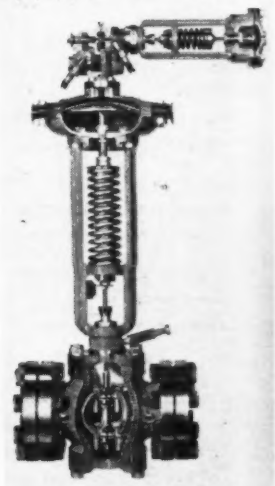
OTHER VALVES *from the* CASH STANDARD LINE



Cash Standard Type 34 Pressure Reducing Valve. For practically all fluids. Has roller bearing, also roller guides that kill side strains and stop packing trouble —no lost motion.

Sizes: ½" to 12" inclusive. Highest initial pressure 800 lbs.; reduced pressure vacuum to 150 lbs. Bodies: iron, bronze, steel. Trim: iron, bronze, stainless steel. Ends: screwed, flanged, ammonia type, welding type. Bulletin 968.

☆



Cash Standard Type 30-AP Valve gives precise control of fluid pressures, through a pilot connected to the pressure under control. For steam, water, air, and most fluids.

Can be a pressure reducing valve or a back pressure valve depending on the way the control lines are connected. Pressures up to 600 lbs. Sizes ½" to 12" screwed; 1" to 12" flanged ends; wide variety of metals.

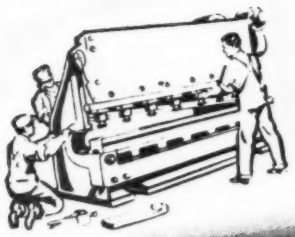
☆

THIS NEW LUBRICATION PLAN Provides a *3 Way Saving!*

❶ SAVES EQUIPMENT

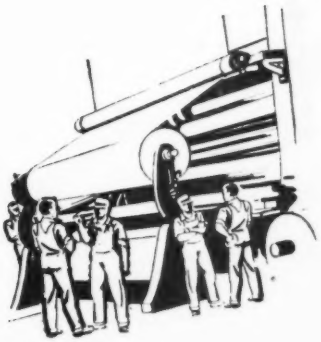
Today, with many types of equipment almost impossible to replace, conservation through proper lubrication is of prime importance. Sun's SAVE and SERVE Plan has been developed to help you make the equipment in your plant run better and last longer . . . by helping you establish a system of proper lubrication.

❷ SAVES PRODUCTIVE TIME



Every breakdown of equipment wastes productive time. Sun's SAVE and SERVE Plan helps you cut down these wasteful periods — when valuable machinery must stand idle unnecessarily — and increases the actual productive time you can expect from your equipment.

❸ SAVES LABOR



Reduce your maintenance time . . . cut your repairs and you save manpower.

Sun's SAVE and SERVE Plan will help you do both — help you make every man-hour a productive hour — by giving you a guide to correct lubrication that anyone can follow. Put Sun's SAVE and SERVE Plan to work in your plant. No charge. It's yours for the asking — includes plant poster, wall chart, lubrication manual, technical bulletins, maintenance memos. Write for folder giving complete details . . .

SUN OIL COMPANY, Philadelphia 3, Pa.

Sponsors of the Sunoco News Voice of the Air—Lowell Thomas

Send in Coupon Today!
No Obligation.

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SUN INDUSTRIAL PRODUCTS

Helping Industry Help America

SUN OIL COMPANY P 2
1608 Walnut Street
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Send folder describing your SAVE and SERVE Plan.

NAME: .....

TITLE: .....

COMPANY: .....

ADDRESS: .....

FOUR OF 25 NEW DIESELS FOR MARITIME COMMISSION BEGIN OFFICIAL TEST RUNS

The photograph pictures a part of the big Busch-Sulzer plant in St. Louis. At the extreme left, one of the main propulsion engines for the Maritime Commission's Type C1-AV1 coastal cargo vessels is making its successful trial run. Next left, a second engine is nearly ready to turn over while the remaining two are rapidly nearing complete assembly.

The C1-AV1 vessels will be used to move troops and materials to combat areas. Each of the twenty-five 4,000 ton ships with Busch-Sulzer Diesels will be propelled by a single direct-connected engine developing 1700 B. H. P. at 180 R. P. M.

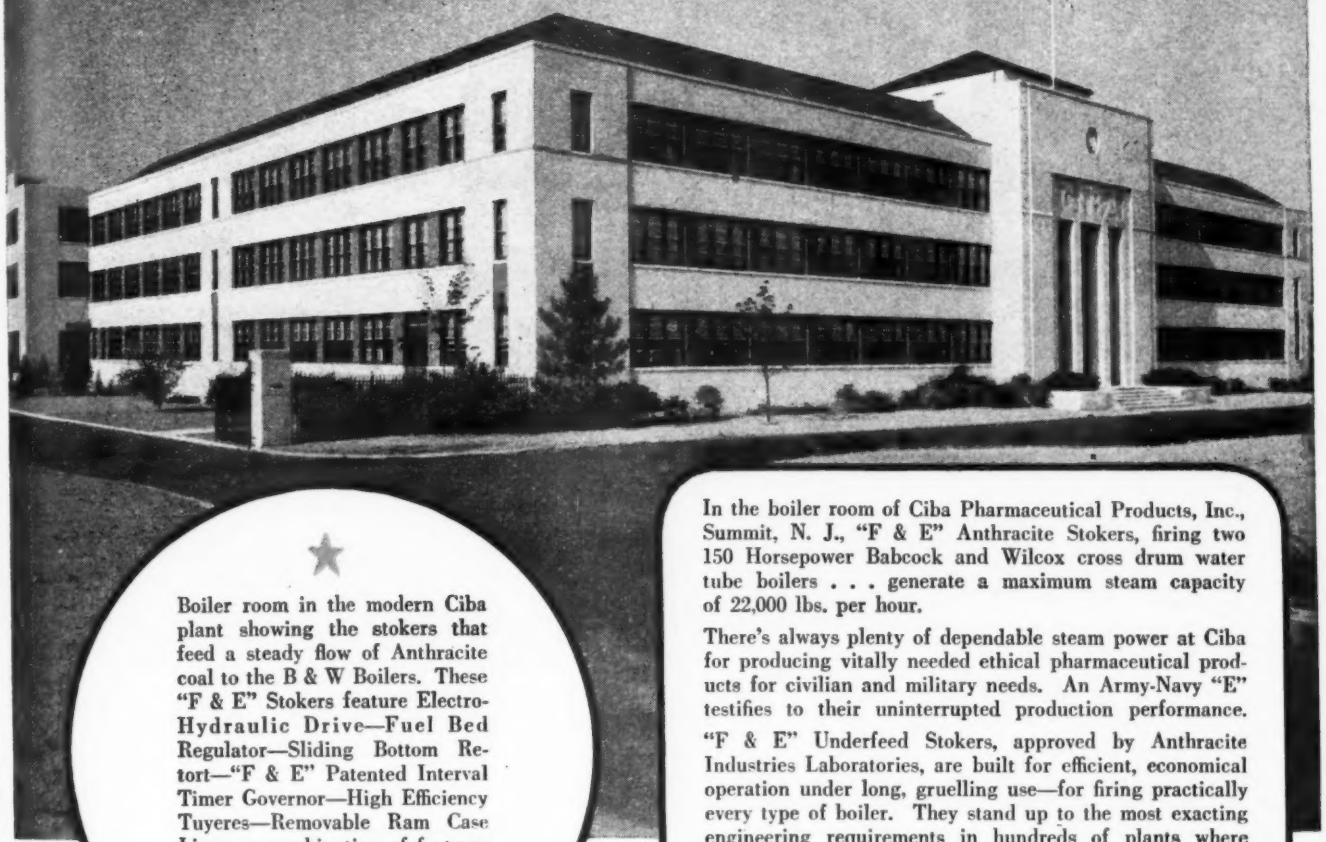
Busch-Sulzer also builds Diesels for other Maritime Commission ships and for vessels of the Army and Navy and marine and stationary engines for orders of high priority. Since a tremendous demand for Diesels is expected to continue for several years after hostilities cease, may we suggest that you acquaint us now with your requirements? We build 4-cycle engines up to 1500 B. H. P. and 2-cycle engines up to 7500 B. H. P. in sizes and speeds to suit a variety of needs. Your inquiry will receive prompt attention.

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY
SAINT LOUIS

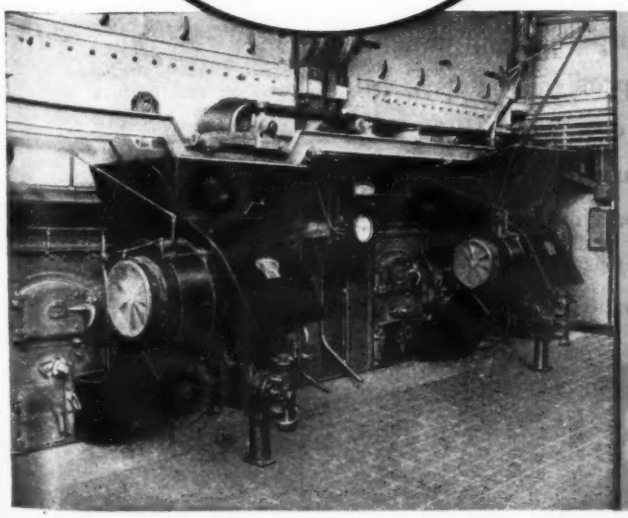
AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

BUSCH-SULZER ST. LOUIS

22,000 LBS. OF STEAM PER HOUR WITH "F&E" STOKERS



Boiler room in the modern Ciba plant showing the stokers that feed a steady flow of Anthracite coal to the B & W Boilers. These "F & E" Stokers feature Electro-Hydraulic Drive—Fuel Bed Regulator—Sliding Bottom Retort—"F & E" Patented Interval Timer Governor—High Efficiency Tuyeres—Removable Ram Case Liner—a combination of features found only in "F & E" Underfeed Stokers.



In the boiler room of Ciba Pharmaceutical Products, Inc., Summit, N. J., "F & E" Anthracite Stokers, firing two 150 Horsepower Babcock and Wilcox cross drum water tube boilers . . . generate a maximum steam capacity of 22,000 lbs. per hour.

There's always plenty of dependable steam power at Ciba for producing vitally needed ethical pharmaceutical products for civilian and military needs. An Army-Navy "E" testifies to their uninterrupted production performance.

"F & E" Underfeed Stokers, approved by Anthracite Industries Laboratories, are built for efficient, economical operation under long, gruelling use—for firing practically every type of boiler. They stand up to the most exacting engineering requirements in hundreds of plants where production is the heaviest in history. Because every "F & E" installation is engineered to the job, it is dependable, fool-proof, efficient and economical right from the word "go."

Your own consulting engineer knows about "F & E" Underfeed Stokers. Talk to him about their possibilities. Or—see the "F & E" representative in your territory.

F&E

UNDERFEED STOKERS

for boilers producing 1,000 to 40,000 lbs. of steam per hr.

are manufactured by

FLYNN & EMRICH CO.

Established 1842

HOLLIDAY & SARATOGA STREETS • BALTIMORE 2, MD.

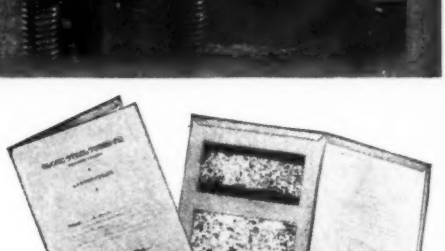
Representatives in Principal Cities

REPRESENTATIVES WANTED in Virginia and the Carolinas. Attractive sales territories and interesting proposition now open to aggressive individual or firm. Write direct for details of franchise.

Complete FACILITIES FOR RESEARCH AND TEST ON TUBING PROBLEMS • • •

Day in and day out, in a spacious building with complete and modern facilities, Globe chemists and metallurgists conduct research on tubing problems. Testing and inspection of Globe Steel Tubes are regular routine. Special problems of customers are studied, too, and physical and chemical tests, spectrographic and microscopic examinations are made, to select the correct analyses for each customer's particular needs. The Globe technical staff is available at the mill or in the field, for technical service on tubing problems.

5007



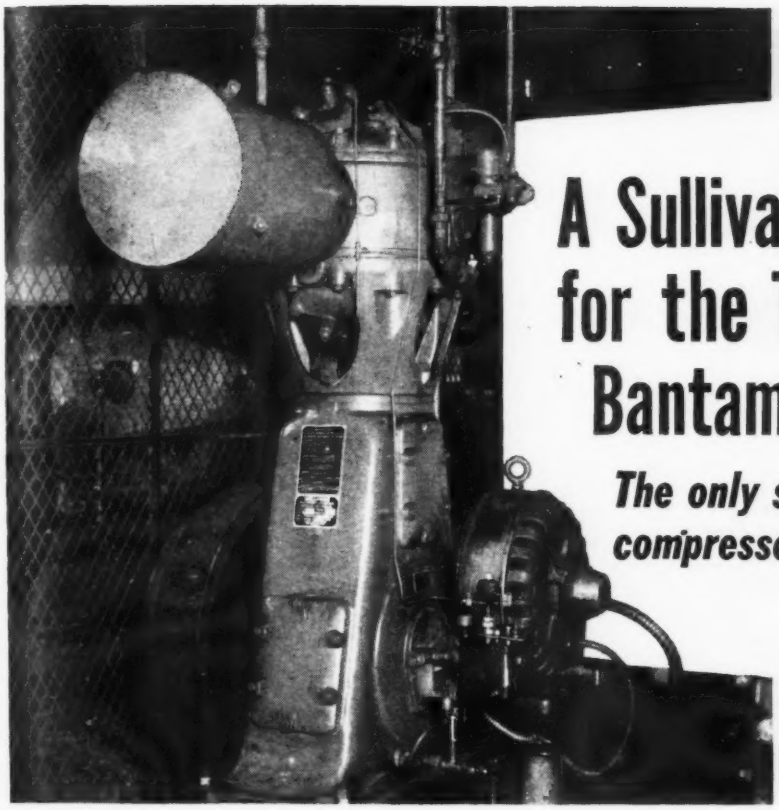
A typical special report, prepared by the Globe laboratory and technical staff.

GLOBE TUBES

★ Boiler and Pressure Tubes
★ Condenser and Heat Exchanger Tubes
★ Stainless Tubes (Seamless)
★ Mechanical Tubing
★ Gloweld Tubes (Welded Stainless)
★ Globeiron Tubes (Seamless Pure Iron)

GLOBE STEEL *Tubes*

GLOBE STEEL TUBES CO. *Milwaukee 4, Wisconsin, U. S. A.*



A Sullivan WG-9 Compressor for the Torrington Company Bantam Bearings Division

The only single-stage, double-acting compressor with these 4 advantages

The Torrington Company, Bantam Bearings Division, already had a Sullivan WG-8 Compressor. Thus they *knew* Sullivan dependability; so when they needed more air, they bought its successor, the Sullivan WG-9. Behind its outstanding performance are features such as the following:

1. Single-purpose alloy steels are *used for single purposes.* Thus in moving parts, Sullivan uses the alloy steels known to resist wear to the utmost. In connecting rods, Sullivan uses the alloys with the utmost ruggedness . . . and drop forged. Again, it has been known for many years that modern single-acting cylinders with honed liners and tinned pistons are almost devoid of wear. That is the construction employed in the WG-9.

2. And to pile value on top of value, cylinder and crosshead liners can be replaced easily, quickly, cheaply . . . to bring back new machine efficiency when actually the compressor is old.

3. The famed Sullivan Dual-Cushion Variable Reaction Valves . . . used in every Sullivan Compressor and proved by hundreds of thousands of hours of faultless performance.

4. The WG-9 Compressor offers maximum capacity per foot of floor area. It has full force-feed lubrication to all working parts—and heavy-duty anti-friction main bearings.

The Sullivan WG-9 Industrial-Air is a heavy-duty compressor for 24 hour service in smaller industries or specialized requirements in larger plants. It is available in 11 capacities, from 153 to 822 CFM, at 30 to 150 lbs. pressure . . . SULLIVAN MACHINERY COMPANY, Michigan City, Indiana. In Canada: Canadian Sullivan Machinery Co., Ltd., Dundas, Ontario.

4 THINGS TO MAKE SURE OF WHEN YOU BUY AN AIR COMPRESSOR

1 ***Are moving parts made of longest-life material available . . . and not a compromise?*** **Note for example, WG-9's generous size crossheads, tin plated and running in mirror-finish honed liners of tough alloy steel . . . almost obviating wear.**

2 ***After long service, can working parts be easily replaced by you in your plant, bringing back "New Machine Efficiency?"*** **The special alloy steel liners in the WG-9 can be thus renewed.**

3 **Are soundest basic engineering concepts followed? How does the valve operate? What about air passages? What is the *truth* about flywheel and pulley wheel combined?**

4 **Is overall design simple, accessible yet built to eliminate the usual adjustment and readjustment so common with compressors? All users agree that Sullivan Compressors never need "break-in" adjustments and give least trouble of any.**

OFFICES

Seattle	Portland	San Francisco	Los Angeles	Salt Lake City
Boston	Pittsburgh	Birmingham	Duluth	Scranton
New York	St. Louis	Knoxville	El Paso	Denver
Chicago	Detroit	Huntington	Butte	Dallas

SULLIVAN

AIR COMPRESSORS

STATIONARY AND PORTABLE AIR COMPRESSORS FROM ¼ TO 3000 H. P., PNEUMATIC CASTING GRIPS, FOUNDATION BREAKERS, PORTABLE HOISTS, ROCK DRILLS

To serve you better

GREENE, TWEED & CO.

has acquired the facilities of

ASBESTOS FIBRE SPINNING CO.

GREENE, TWEED & CO., manufacturer of PALMETTO and other Self-Lubricating Packings, announces that it has acquired the facilities of THE ASBESTOS FIBRE SPINNING CO. of North Wales, Pa., manufacturer of asbestos textiles.

The combined facilities of the large modern plants of these two concerns are now united under a single management. All processes involved in the manufacture of asbestos packings and asbestos textiles are completely controlled—from raw material to finished products. Single management assures supplying your requirements for the high quality products shown at the right.

GREENE, TWEED & CO. Asbestos Packings

- PALMETTO . . . for steam, hot water, gases
- PELRO . . . for oils, solvents
- CUTNO . . . for alkalis
- SUPER-CUTNO . . . for acids
- KLERO . . . for foods, paper products
- PALMETTO HIGH PRESSURE SPIRAL
- PALMETTO CAB COCK PACKING . . . for high temperatures
- SUPERSHEAT . . . all-purpose sheet packing

ASBESTOS FIBRE SPINNING CO. Products

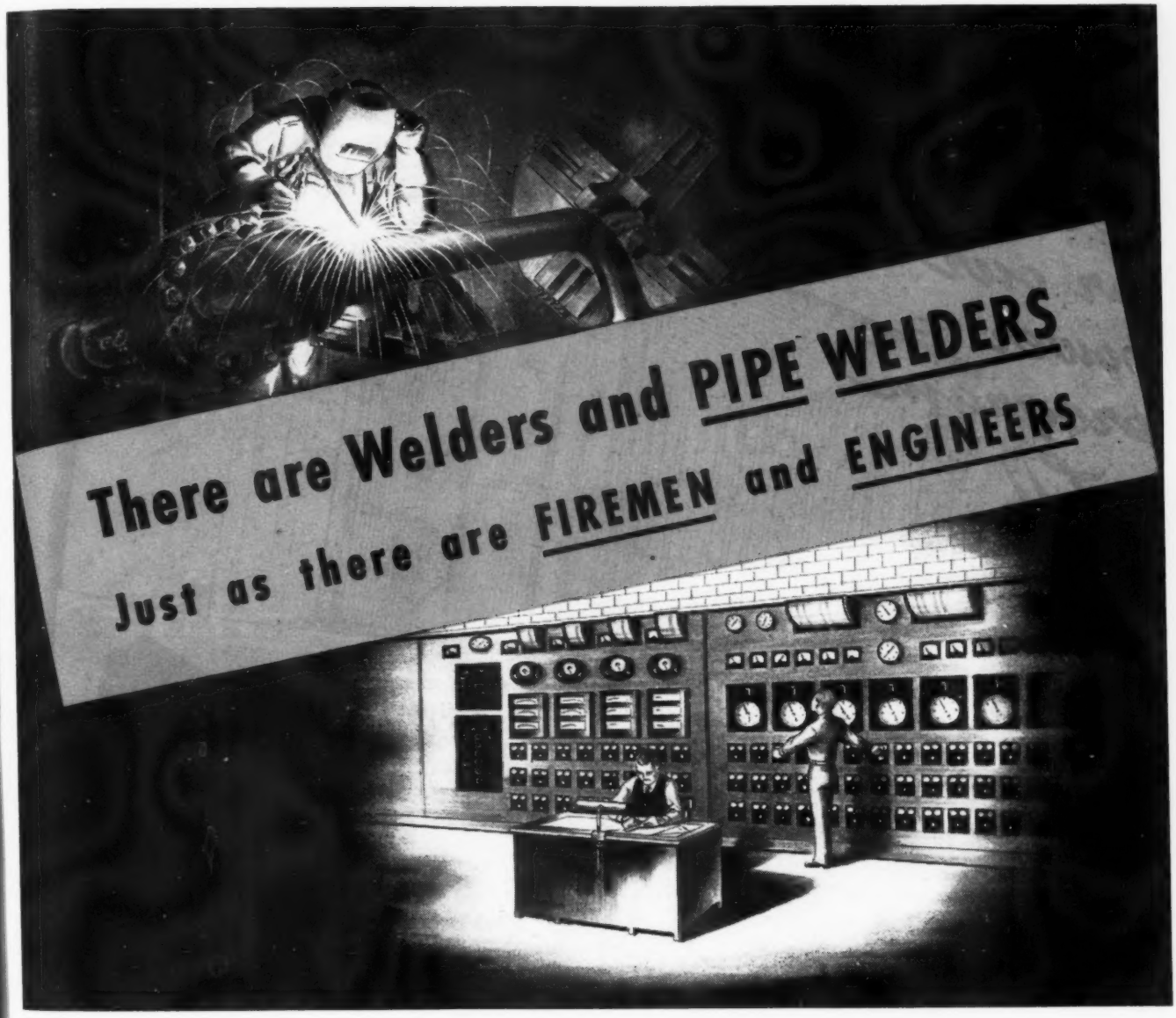
- Braided Tubing
- Carded Fibre
- Cloth
- Gaskets, Handhole & Manhole
- Gaskets, Plumbing & Closet
- Metallic Sheet Packing
- Rope, Twisted and Braided
- Wick Packing
- Yarns, thread and cord

All correspondence should be addressed to
GREENE, TWEED & CO.
Bronx Blvd. at 238th St., New York 66, N. Y.

GREENE, TWEED & CO.

BRONX BOULEVARD AT 238th ST. NEW YORK 66, N. Y.

PLANTS: New York, N. Y. and North Wales, Pa.



. A fireman or water tender serves a useful purpose . . . we couldn't get along without him. But he isn't an engineer. The engineer must have training and experience which the other man has not yet acquired. Many men are satisfactory firemen or water tenders who do not have the special aptitude to become good engineers.

Ordinary welders may be capable enough for ordinary work . . . but they aren't pressure piping welders. Operators capable of welding pressure piping must have special aptitude, careful training and plenty of experience. They must be painstakingly qualified in different positions and tested on procedures for various classes of materials.

Welders of these abilities are not easy to find . . . particularly in times of heavy demand for skilled labor. Pipe fabricators employ large numbers of qualified pressure piping welders. These welders work under the most favorable conditions and are closely supervised to make certain they exactly adhere to predetermined welding procedures that have proved correct for the particular job. Their work meets the most exacting standards . . . piping so fabricated is insurable.

Purchase of pre-fabricated piping from qualified fabricators is the best and most economical way to obtain quality pressure piping.

P.F.I.
THE PIPE FABRICATION INSTITUTE
THE PIPE FABRICATION INSTITUTE
Devoted to the Technical and Economic Problems in Piping
1108 CLARK BUILDING • PITTSBURGH, PA.
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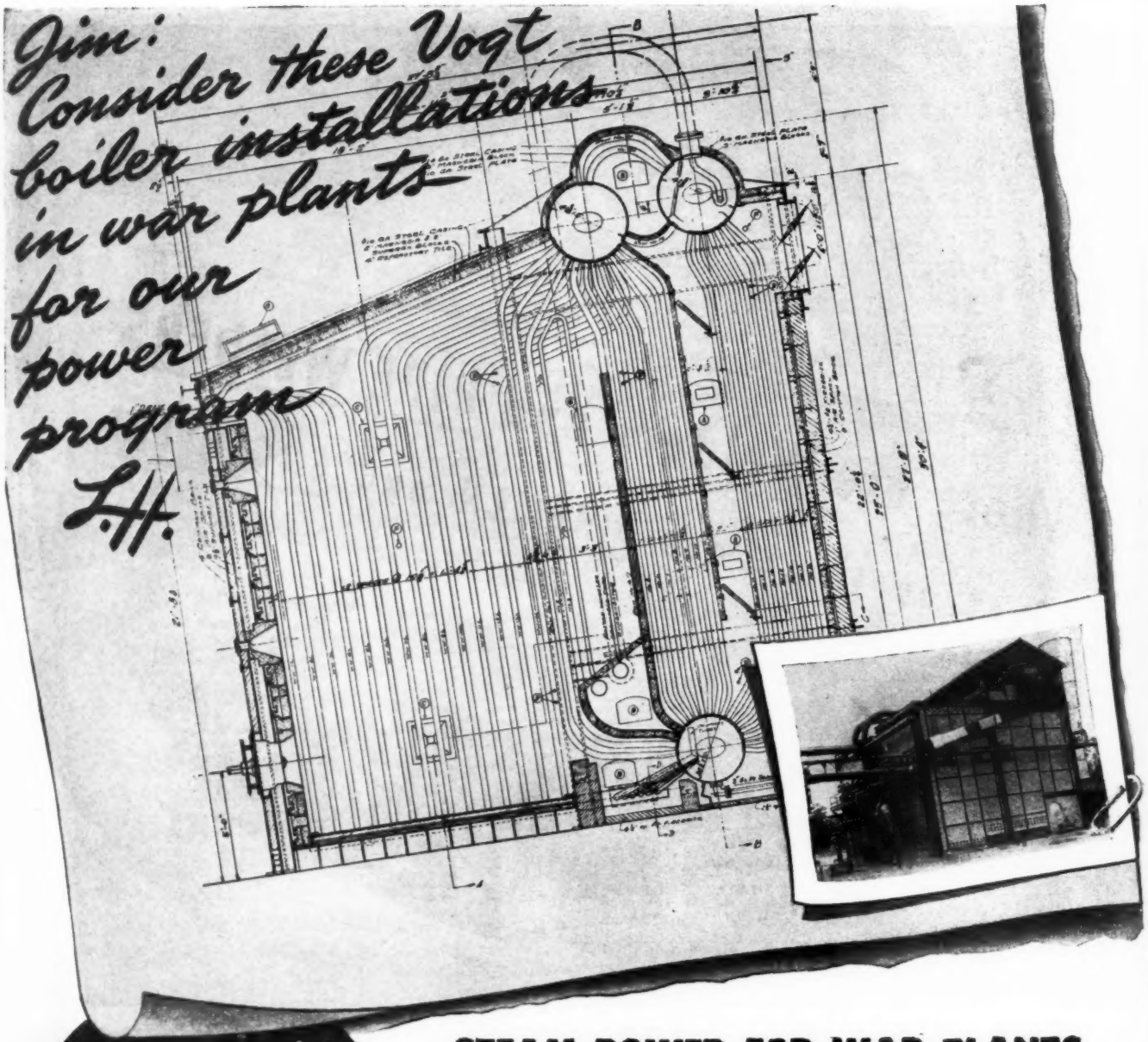
Jim: Consider these Vogt boiler installations in war plants for our power program
L.H.

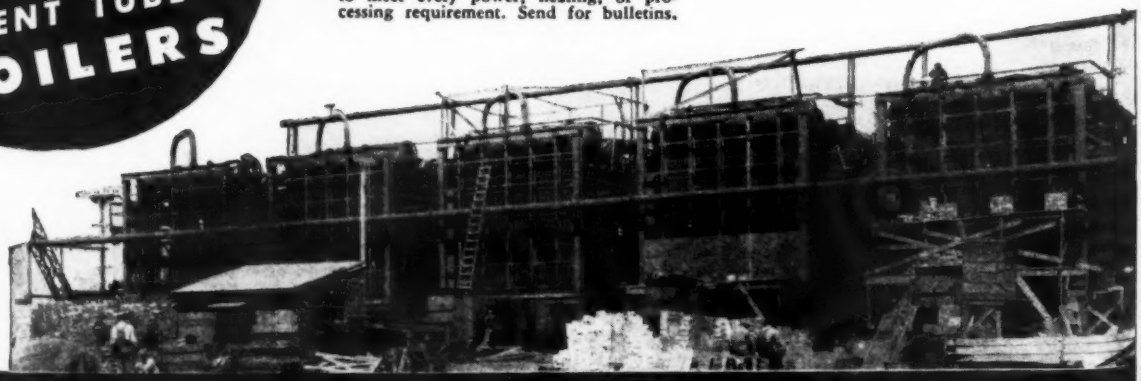


Vogt
CLASS VR BENT TUBE BOILERS

STEAM POWER FOR WAR PLANTS

These Oil and Gas Fired Steam Generators are working round-the-clock in war plants producing 100 octane gasoline and synthetic rubber components . . . all vital to Victory!

Vogt builds steam generating equipment to meet every power, heating, or processing requirement. Send for bulletins.

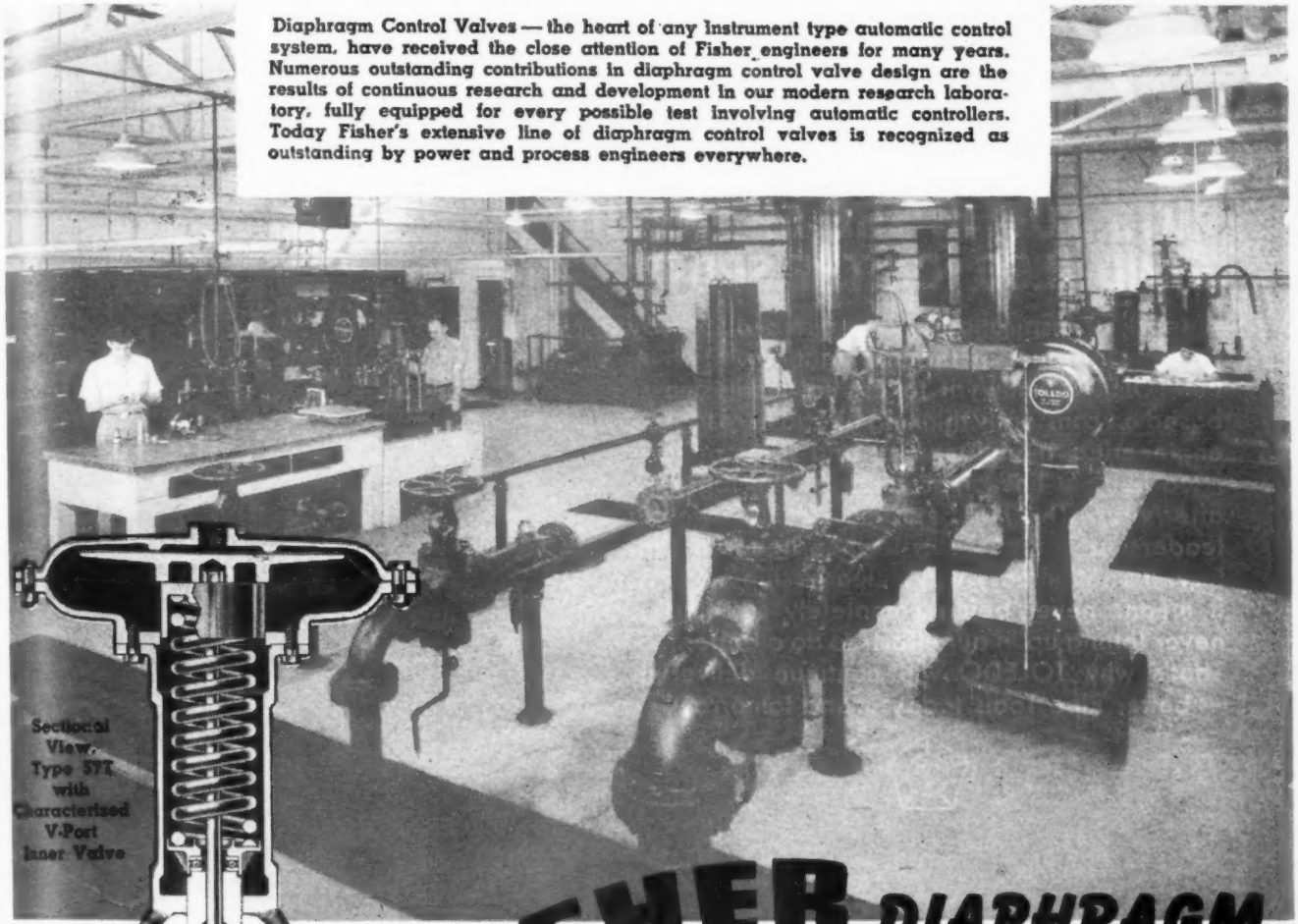


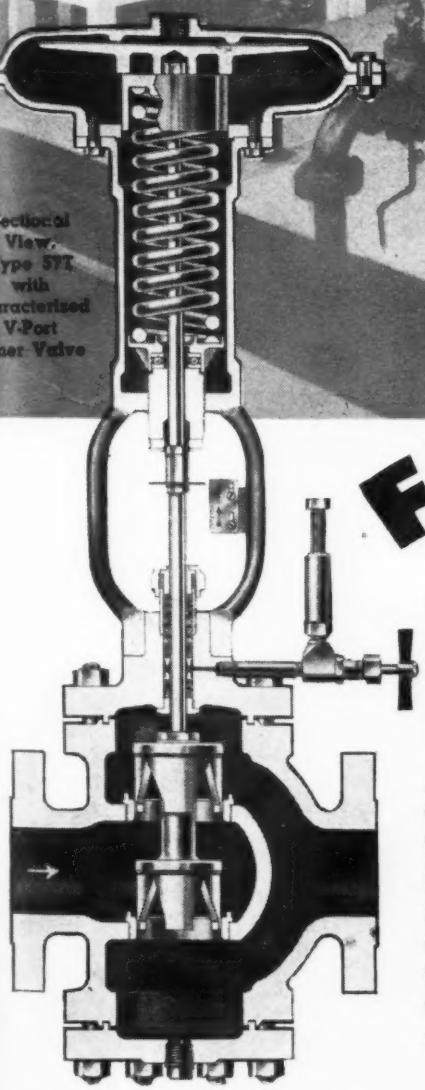
HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KENTUCKY

Branch Offices: New York - Chicago - Cleveland - Philadelphia - Dallas

★ THE HEART OF ANY INSTRUMENT TYPE AUTOMATIC CONTROL SYSTEM ★ ★ ★ ★

Diaphragm Control Valves — the heart of any instrument type automatic control system, have received the close attention of Fisher engineers for many years. Numerous outstanding contributions in diaphragm control valve design are the results of continuous research and development in our modern research laboratory, fully equipped for every possible test involving automatic controllers. Today Fisher's extensive line of diaphragm control valves is recognized as outstanding by power and process engineers everywhere.



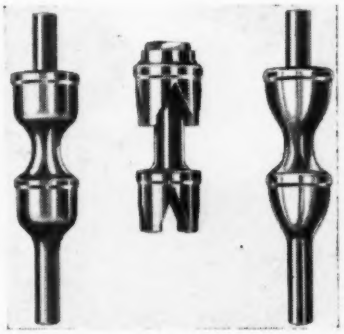


Sectional View, Type 57T with Characterized V-Port Inner Valve

FISHER DIAPHRAGM CONTROL VALVES

are designed to control the flow of all kinds of fluids at all temperatures and pressures. Operated through the action of a primary pilot valve supplying auxiliary pressure to the diaphragm, they provide full throttling control in exact accordance with the dictates of the pilot valve.

Available with a wide selection of inner valve designs — Characterized V-Port, Throttle or Ratio Plug, Single Port Needle Point, and many others. Each valve structure provides a specific type of flow curve. Fisher Engineers are always ready to recommend the correct type of inner valve and body design to exactly meet your requirements.



FISHER GOVERNOR COMPANY, 431 FISHER BLDG. **MARSHALLTOWN, IOWA**

Leadership

PUTS YOU IN THE SPOTLIGHT —AND ALSO "ON THE SPOT"!

A spark of inspiration or a stroke of luck may put any product in the spotlight for a while. But TOLEDO knows it takes *real leadership* ... based on constantly thinking ahead in research, engineering, manufacturing and sales policies ... to keep a line of products at the top year after year. This has been the TOLEDO way of leadership in Pipe Tools for nearly half a century. It's not an easy way... leadership never is. It means never being completely satisfied... never letting up in our efforts to do a better job. That's why TOLEDO will continue delivering better Pipe Tools today... and tomorrow.

SELF-CONTAINED SIMPACT
for pace-setting efficiency

One set of high speed steel dies does the work of four—with a TOLEDO Simpact Threader! Threads 1" to 2" pipe. Sizes changed instantly. Entirely self-contained. No loose parts. Designed for easier operation and long dependable service. In ordering from your dealer, specify a TOLEDO Simpact—the *unbeatable* self-contained threading tool!... The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office, No. 2 Rector St. Bldg.

TOLEDO

PRECISION PIPE TOOLS

Armstrong traps make Boilers Bigger!

56.25% Less Boiler Capacity Needed

The Midland Chemical Company, Dubuque, Iowa, had placed an order for a new 125 H.P. boiler, but found that the recommendations of an *Armstrong Trap Representative* for a new return system and Armstrong Trapping so increased efficiency they were able to change the order to an 80 H.P. boiler instead!

Fuel oil consumption was cut from 1,500 down to 700 gallons a week.

The boiler room did not have to be enlarged as would have otherwise been necessary.

Faster heating and higher, more uniform temperatures were secured on process equipment.

IT'S A GOOD HABIT TO CALL IN AN ARMSTRONG TRAP MAN IF YOUR PROBLEM HAS TO DO WITH STEAM.

ARMSTRONG INVERTED BUCKET STEAM TRAP

WHEN ARMSTRONG TRAPS replace inefficient drainage devices or old, obsolete traps, the resulting steam saving usually is equivalent to a sizeable increase in boiler capacity. Here is how this is accomplished.

STEAM TIGHT VALVES. Armstrong valve parts remain steam tight for a long time because:

1. Valves and seats are water-sealed at all times.
2. Valves and seats are made of chrome steel. The parts are heat treated after machining. The ball valves are precision ground. Valves and seats are lapped together.
3. Free floating lever lifts valve to seat without leverage, minimizing wear.

AUTOMATIC AIR ELIMINATION. This saves steam in several ways:

1. No manual blowdown necessary to rid pipe or steam heated unit of air.
2. Bypass valves not needed with Armstrong Traps. A bypass valve left open accidentally or on purpose will shrink boiler capacity a lot.
3. By keeping air out of steam heated process equipment, work can be done in a shorter time, thereby reducing non-productive radiation losses.

SELF-SCRUBBING ACTION. This saves steam because:

1. It prevents accumulation of dirt which would interfere with trap operation.
2. Dirt will not lodge between valve and seat to prevent tight closing of the trap valve.

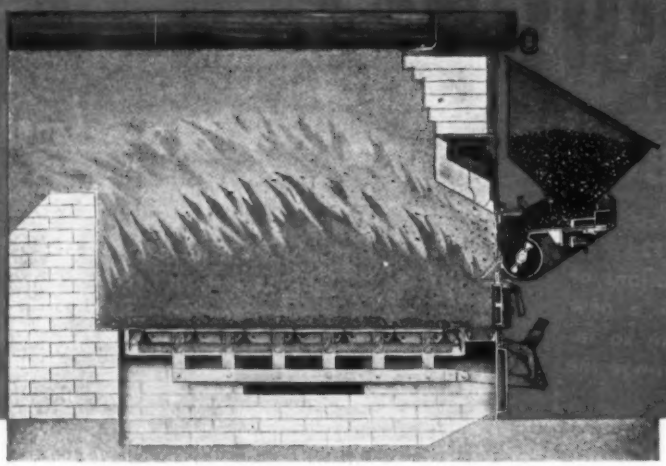
For more than thirty years, the Armstrong Machine Works has specialized on making inverted steam traps and Armstrong Representatives have specialized on mastering trap selection and installation problems. Call on this combination to handle your trapping problems. Write today for Catalog.

ARMSTRONG MACHINE WORKS

812 Maple Street • Three Rivers, Michigan

Advanced Firing Equipment

BROS MODEL 16 SUPER-SPRED STOKER



Burns all Coals
Quicker Response
Low Maintenance
Quickly Installed

Out of an experience of 60 years, Bros engineering has developed advanced firing equipment—the Bros Model 16 Super Spred Stoker, capacity 1500 lbs. of coal per hour. It is the modern tool for producing power—cheaper as to fuels and maintenance—greater efficiency in meeting firing requirements—better all-round performance.

Bros frees you from reliance on any one type of fuel. For with the Bros Stoker you can burn any type or kind of coal, the cheapest locally available. If you have factory waste that is combustible it can be utilized in combination with coal. Your recent experiences will remind you what an important advantage this is, both now and in the future

The drawing above illustrates the firing action. Coal flows from hopper to a reciprocating feeder shoe, on to overrunning rotor, which spreads coal uniformly over entire grate in a shallow fuel bed. The fines release their volatiles, ignite, burn in suspension. The coarser sizes burn on the grates. Low velocity forced draft is supplied uniformly to all sections of grate

Bros spreader stokers operate at high efficiency whether the load is a heavy continuous one or widely fluctuating. Bros follows the load. The thin, evenly distributed fuel bed responds more readily to changing demands. There are no banking losses. No popping when the load falls off suddenly. Ash is kept below the fusion point. No heavy clinkers to remove.

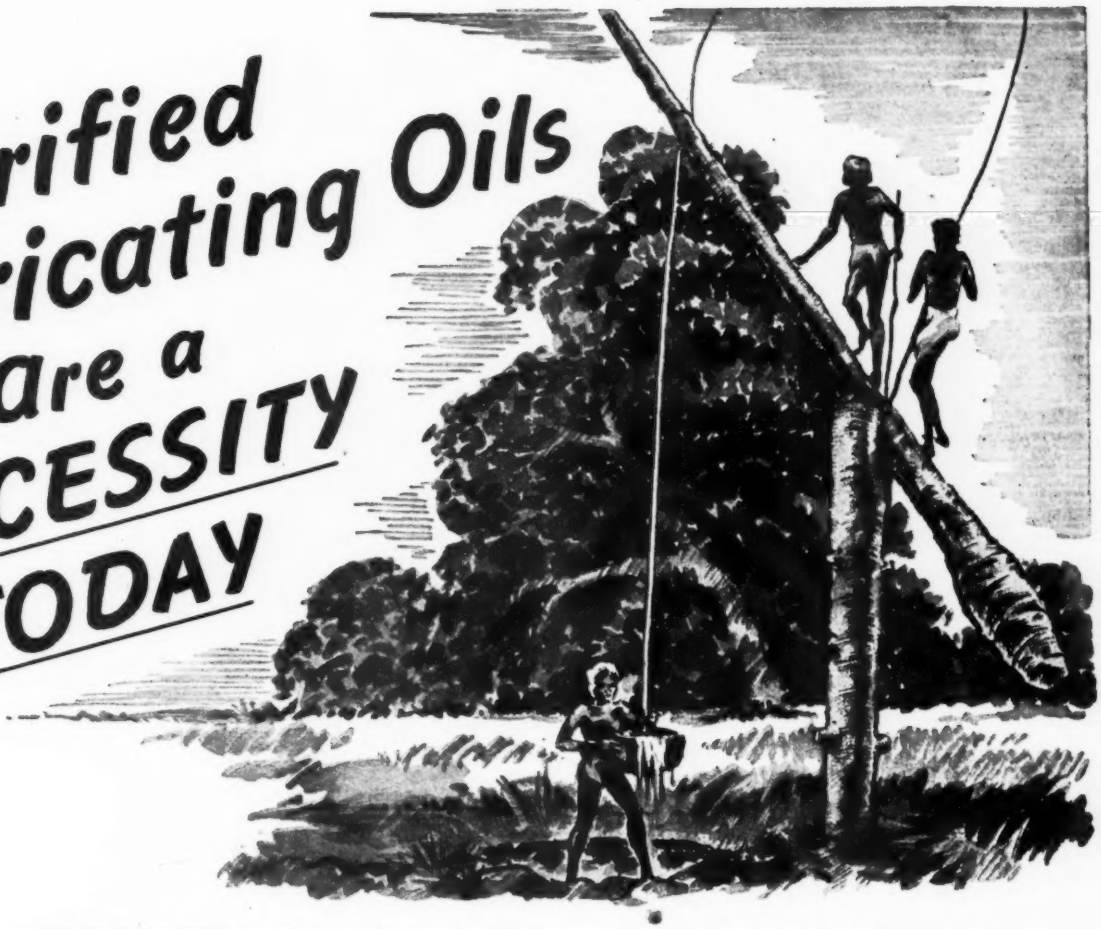
Write for illustrated literature. Discover the wealth of sound engineering that has gone into making this modern firing tool the last word in power equipment. Bros representatives are located to serve your needs promptly, with complete data.

Descriptive Literature on Request

WM. BROS BOILER & MFG. CO.
Minneapolis 14, Minnesota

BROS MODEL 16 *Super Spred* STOKER

Purified Lubricating Oils are a NECESSITY TODAY

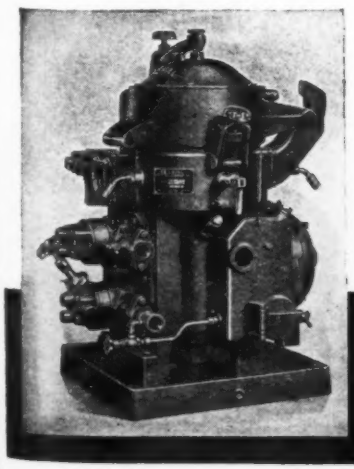


BECAUSE the primitive well-sweep was a simple, slow-moving device, its lubrication presented no problems. Engines and turbines of today, however, not only demand the very utmost of the oil refiner's skill but require further that the lubricants be kept continuously free from contaminating foreign matter. The most positive and economical way of keeping oil in "like new" condition is by means of the De Laval Centrifugal Oil Purifier.

De Laval Oil Purifiers instantaneously remove the impurities that contaminate lubricating oil in service—water, sludge, carbon and dirt. Oil from which these trouble makers are continuously removed will perform at full efficiency indefinitely.

De Laval Oil Purifiers are available either as separate units or in the "Uni-Matic" type which is complete with pumps and, if desired, with heaters. All sizes and models of De Laval machines make possible the same high degree of protection to bearings and moving parts.

Write for additional details.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 — 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL — PETERBOROUGH — WINNIPEG — VANCOUVER

DE LAVAL OIL PURIFIERS

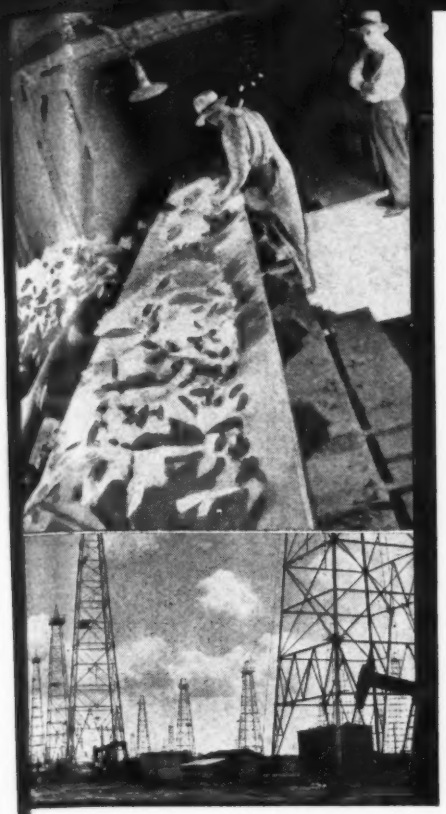
The Pilot

GIVES YOU POSITIVE CONTROL

The special "metering pilot" in the K & M *Remotrol* Liquid Level Control gives you instantaneous precision valve action. The slightest rotation of the stuffing box shaft is immediately transmitted to apply or release pressure on the diaphragm motor valve. The slightest change in liquid level thus is automatically corrected. This most accurate of level controls can be furnished with a "V" port, parabolic, or beveled type Inner Valve of bronze, Monel, stainless steel. Special alloys can be furnished on application. For dead end service, a single seated main valve may be had. We invite you to submit your "hard-to-solve" control problems to our Engineering Department.

Write for General Catalog 66

KIELEY & MUELLER, INC.
MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS
NORTH BERGEN, NEW JERSEY



JAP or no JAP

● Industrial war production has increased constantly since Pearl Harbor and vital mechanical rubber products have been built to contribute their share, Jap or no Jap. Relying on their pre-war experience with synthetics, Republic Rubber has designed and built all types of belting, hose and other products from man-made rubbers. The ingenuity and determination in American industry, overcoming natural rubber shortages and other difficulties, is the home front share in defeating the Axis.

Accredited Distributor

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YOUNGSTOWN 1 • • OHIO

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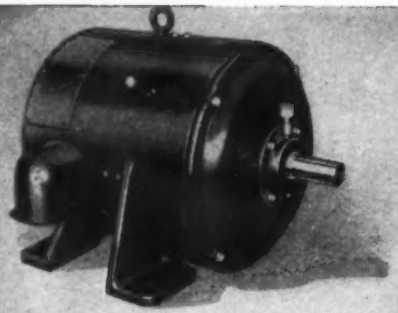
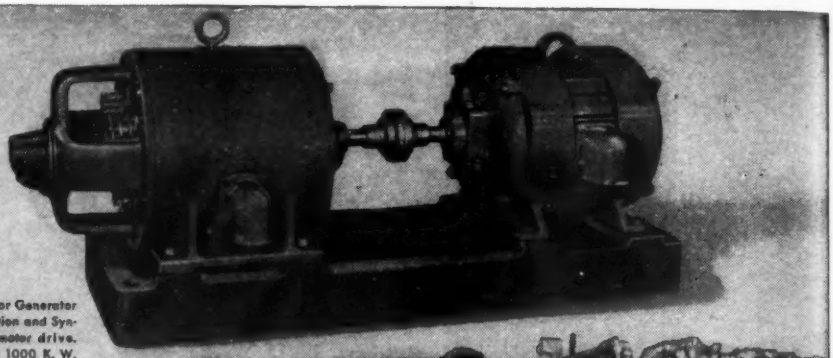
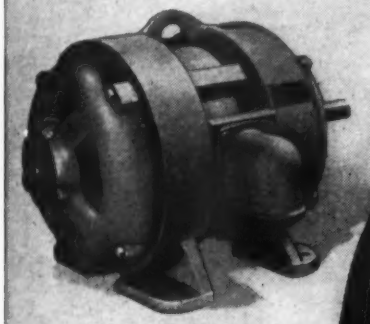


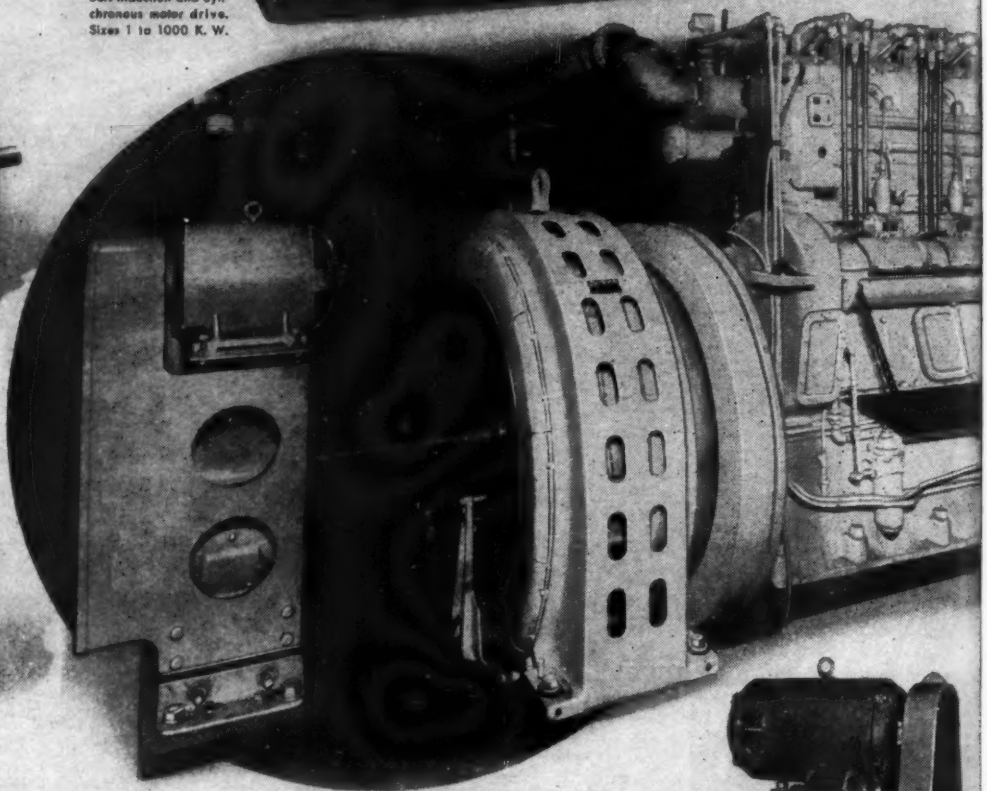
Burke Bracket Type D.C. Motors and Generators. Sizes 1 to 1000 K.W.



Burke Motor Generator Sets Induction and Synchronous motor drive. Sizes 1 to 1000 K. W.

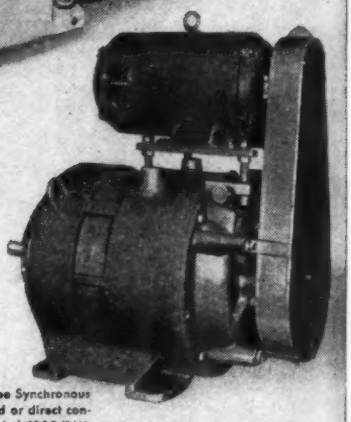


Burke Induction Motors, ball or sleeve bearing. Sizes 1 to 1500 H. P.



Burke A.C. Engine Type Synchronous Generators. Sizes 25 to 1000 K. W.

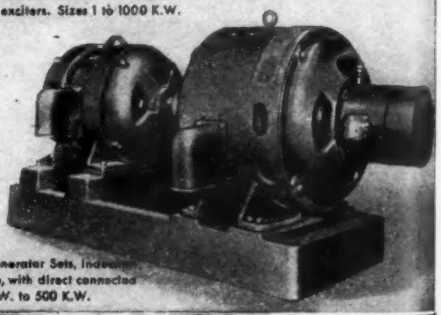
Burke Vertical Induction Motors for pump drive. Sizes 1 to 1500 H. P.



Burke A.C. Bracket Type Synchronous Generators with belted or direct connected exciters. Sizes 1 to 1000 K.W.

Designed for the Job

BURKE offers to industry a highly specialized experience in applying its wide range of standardized motors and generators to meet specific requirements from one horsepower up. Wherever the maximum in capacity and overload are demanded, it will pay you to get Burke's recommendation, for Burke stresses quality and workmanship in every detail. You can depend on a Burke for more than its rating.



Burke High Cycle Motor Generator Sets, Induction or Synchronous motor drive, with direct connected exciters. Sizes 5 K.W. to 500 K.W.

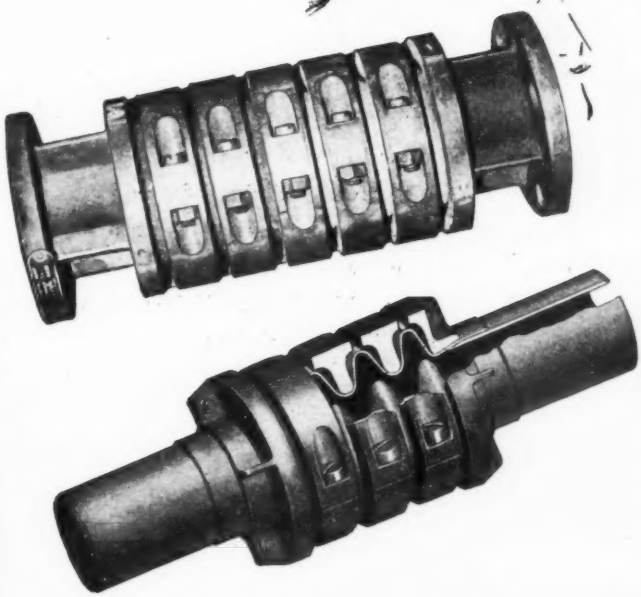
MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

Ring Controlled "PACKLESS" EXPANSION JOINTS

They roll with the punch!



For the same reason you cheer a clever boxer, you'll commend Badger Ring Controlled Packless Expansion Joints which compensate so faultlessly, so automatically for every expansion, vibration or axial movement of the most obstinate pipe line.

Made in copper, stainless steel or other suitable alloys by special processes which eliminate strains and stresses in the metal.

Perfectly adapted for steam, air, liquid or gas lines and joint-tight without packing.

Badger Ring Controlled Packless Expansion Joints are made to order with single or multiple corrugations and in flanged or welded types to meet your particular requirements.

Complete catalog on request

BADGER RING CONTROLLED EXPANSION JOINTS

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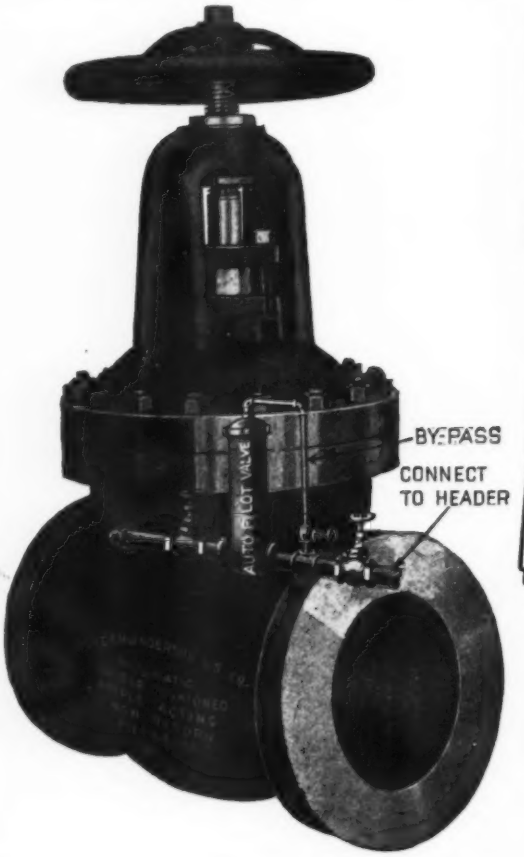


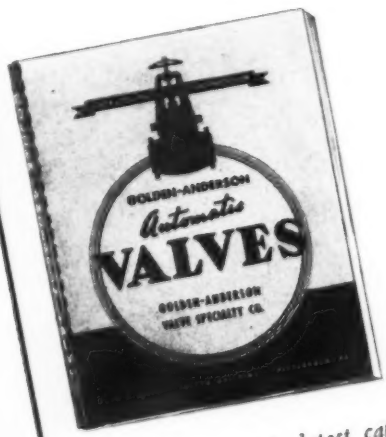
Golden-Anderson

TRIPLE-ACTING NON-RETURN VALVE

- **Automatically cuts in a boiler whenever its pressure equals line header pressure.**
- **Isolates a boiler automatically whenever its pressure, from any cause, is lower than line-header pressure.**
- **Prevents steam flow from boiler in event of sudden drop below boiler pressure by means of differential shot pilot valve functioning.**

The GOLDEN-ANDERSON Triple-Acting Non-Return Valve is today protecting thousands of boiler rooms against the disastrous effects of a bursted tube or other boiler rupture by automatically cutting off the inflow of steam from the whole line the instant the rupture occurs. Get this life and property protection for *your* boiler room! Non-Return Valves are supplied in Angle, Globe and Elbow patterns in sizes 2½" to 12" . . . a size and type to meet every plant requirement.

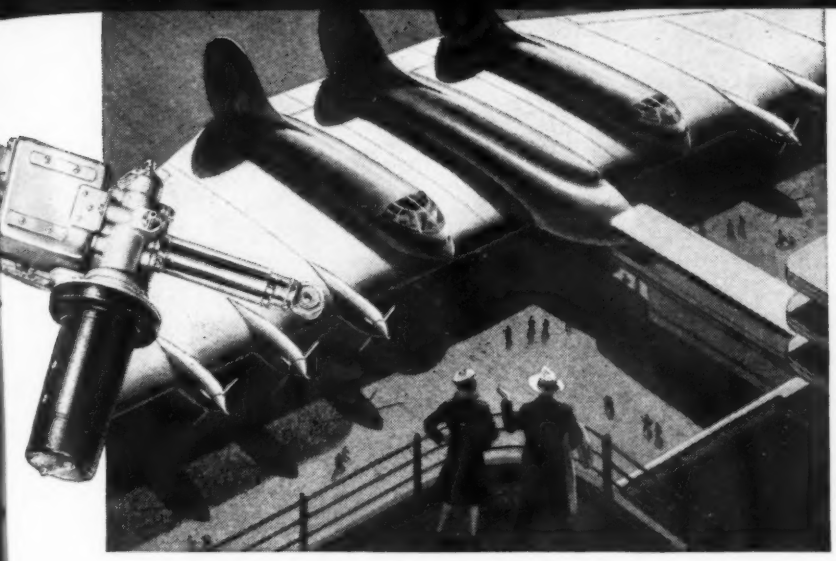
Write today for detailed information on the G-A Non-Return Valve. Complete operation and construction data will be sent immediately.



Copies of this latest catalog, containing full descriptions of all G-A Specialty Valves, will be sent on request. Write for yours today!

GOLDEN-ANDERSON
VALVE SPECIALTY COMPANY

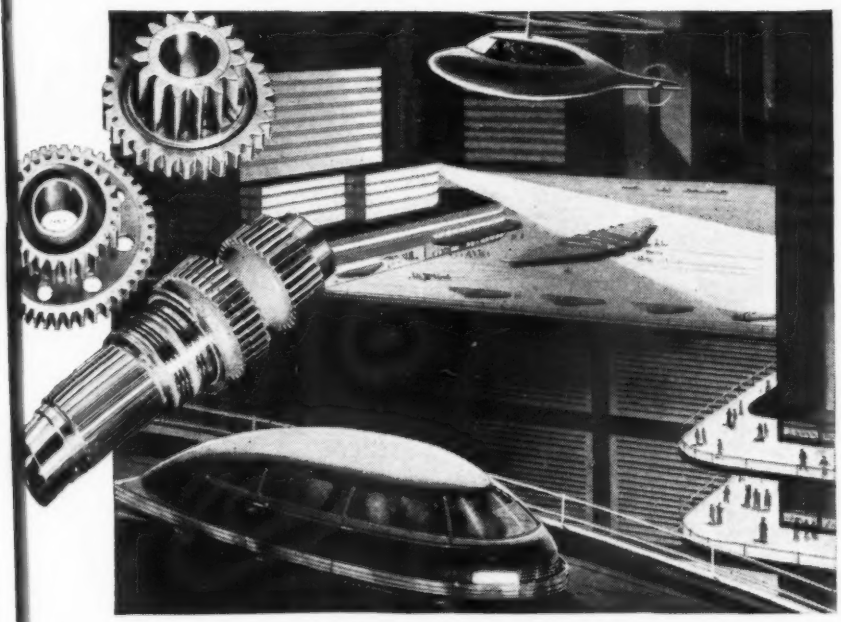
1300 FULTON BLDG., PITTSBURGH, PENNSYLVANIA



These compact, efficient packages of power will perform many of the jobs in controlling the flight of tomorrow's skyliners. Their high precision has won them a place in today's fighter planes.

PROMISE OF A BRIGHT FUTURE

in the Transmission of Power...



Mass production of high precision gears will assure more efficient performance—greater compactness and increased speed in tomorrow's machines.

THE demands of war have brought a revolution in the economical transmission of power. Here at Foote Bros. new advances in engineering—new developments in the manufacture of extremely high precision gears, speed reducers and aircraft devices, give promise to American manufacturers of a new era of "better power transmission through better gears" when the war is won.

Tomorrow these new developments may solve problems for you in the equipment you manufacture. When that time comes, you may look to Foote Bros. for gears and speed reducers in any size—held to the tolerances you require. Foote Bros. will also be able to offer you an engineering service to assist your designers in any power transmission problem requiring the use of gears and speed reducers.

Improved speed reducer designs assure greater compactness—smoother operation and a new efficiency to tomorrow's equipment manufacturers.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 South Western Boulevard, Chicago 9, Ill.

FOOTE BROS.

Better Power Transmission Through Better Gears

LOSING B.T.U.s?

SIMPLY APPLY UNIBESTOS

it's simple to apply!

Consider these important heat-saving factors in UNIBESTOS construction and method of application: It is available in half-section form up to 30" pipe diameter and in quarter sections from 32" to 60", in thicknesses from ¾" to 5" . . . affords a neat, tight job without efficiency-impairing gaps. Standard UNIBESTOS is available for service up to 750°; combinations of Standard and Super UNIBESTOS in single layer construction are available for service up to 1200°. These temperature limits permit the use of one material at maximum efficiency for a wide range of purposes.

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

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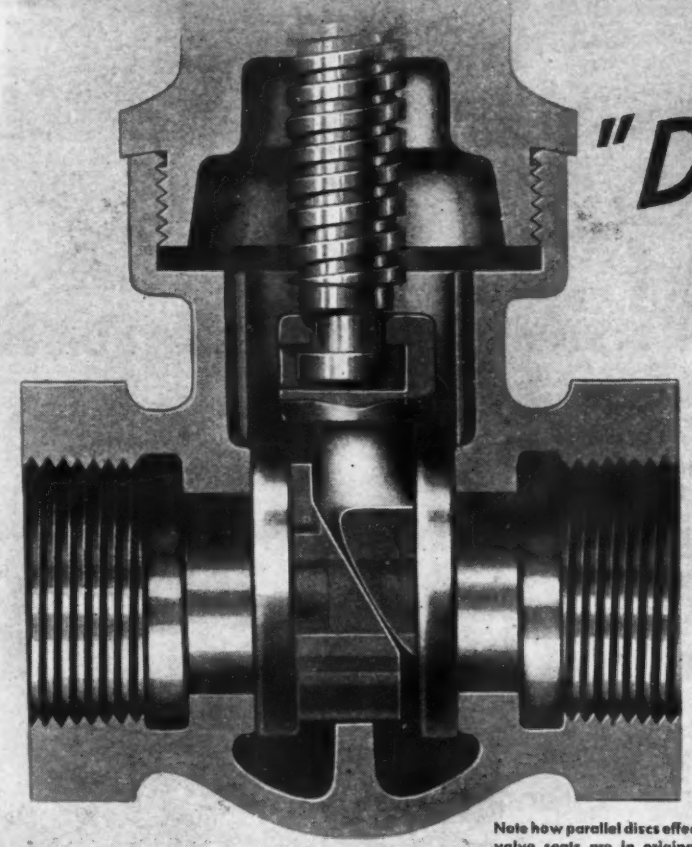
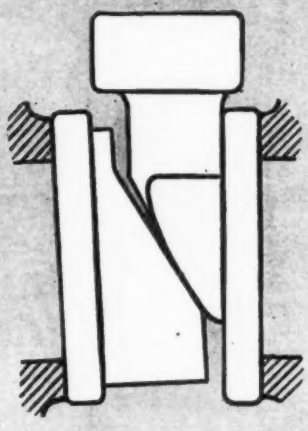
UNION ASBESTOS & RUBBER CO.

PLANTS: 1821 S. 54th Ave., CICERO, ILL. • PATERSON, N. J. • BLUE ISLAND, ILL.
OFFICES: CHICAGO • CICERO, ILL. • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

DARLING...the valve that can give you "DROP-TIGHT" SEATING...

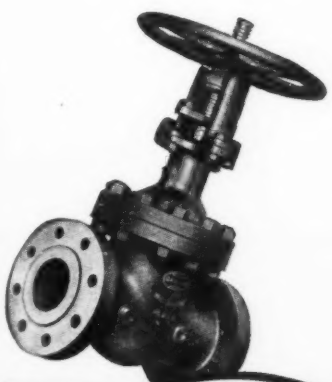


Note how parallel discs effect tight closure when valve seats are in original parallel position.



This greatly exaggerated diagram shows how the curved face of the upper wedge allows the discs to fit against seats, "unparalleled" by valve body distortion.

Darling manufactures a quality line of gate valves for long service—in parallel seat or tapered seat—slotted or solid wedge types—for service pressures up to 3000 pounds. Valves are available in cast iron, bronze, cast steel, forged steel, corrosion resisting and special alloys. Darling also manufactures check valves, compression type fire hydrants, motor and cylinder operated valves, and accessories.



THERE is one gate valve design that insures "drop-tight" seating, year after year. It is the unique Darling design. Darling's fully revolving double disc parallel seat gate valve provides:

1. ADAPTABILITY—Any valve can close tight the day before it is installed. But the day after is another story. Pipe out of alignment and bolting strains distort valve bodies. Pressure and temperature changes and other operating strains force valve bodies out of shape, too, so that gate and seats do not remain parallel.

To compensate for "unparalleled" seats, in the Darling valve wedging assembly a straight or tangent surface on the lower wedge acts on a curved or "radius" surface on the upper wedge. So no matter what position valve seats reach in years of usage, the Darling twin discs make perfect closures.

2. UNIFORM WEAR—The twin discs are free to revolve 360°, seating in a different position each time the valve is operated. Wear on discs and seats is uniform, making possible tight closing year after year.

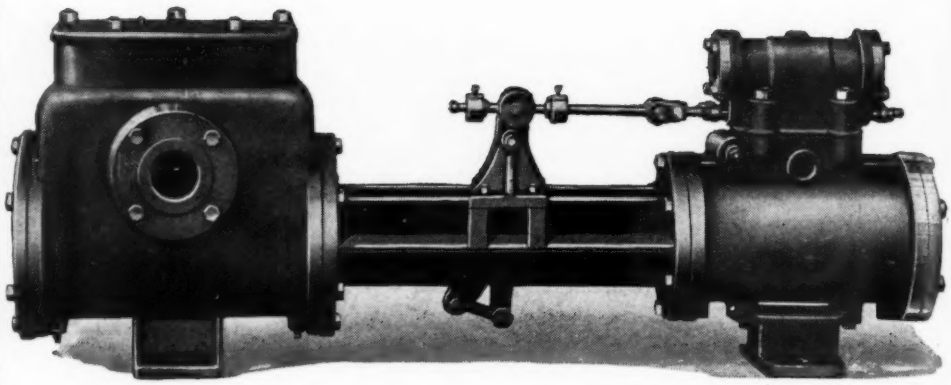
3. INSTANT RELEASE—The four simple parts of the valve assembly—two discs, two wedges—release at the first fractional turn of the stem to open. The gate is immediately free to rise with little or no friction.

For over 40 years engineers have found that Darling Valves give "drop-tight" shut-off, long life and low maintenance.

NOW—when maximum uninterrupted production is all-important—you can safeguard it by installing Darling Valves. Later, when low-cost operation and maintenance are vital, you will be all set with valves that help you keep costs down and help you compete in postwar markets.

TRADE DARLING MARK VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

Plan for the Future Right Now with



WARREN STEAM HEAT VACUUM PUMPS

It's not too early to check over your requirements for Steam Heat Vaccuum Pumps that you may need next Fall and Winter.
Look over these abbreviated "specs":

Look over these abbreviated "Specs"

RIGIDLY SUPPORTED ALL-STEEL VALVE GEAR

Note double fork type lever. Contrast this construction with single pedestal overhung type frequently used.

STEAM END

Steam cylinder and head, hard, close-grained, cast iron with thick cylinder walls suitable for reboring.

Steam valve mechanism, Warren patented "Eclipse" type. This valve mechanism insures positiveness of operation, full length of stroke and economy of steam consumption.

Valve gear, outside adjustable type, can be adjusted while pump is in operation.

Centerpiece, cast iron with reinforced side walls to prevent any distortion, thereby insuring permanent alignment to entire unit. Piston rod stuffing boxes cast integral.

LIQUID END

Liquid cylinder, head, and cap, hard, close grained, cast iron. Centrifugally cast bronze liner.

Liquid piston, cast bronze fibrous packed type with removable follower for packing adjustment or renewal.

Liquid valves, standard fitted pumps furnished with phosphor bronze, multi-disc type valves. Hard rubber disc type or stainless steel multi-disc type valves can be furnished.

Liquid valve seats, cast bronze, grid type, driven into valve decks on a smooth taper.

Piston rod, solid rolled bronze with tapered shanks and nuts for securing pistons.

Send for

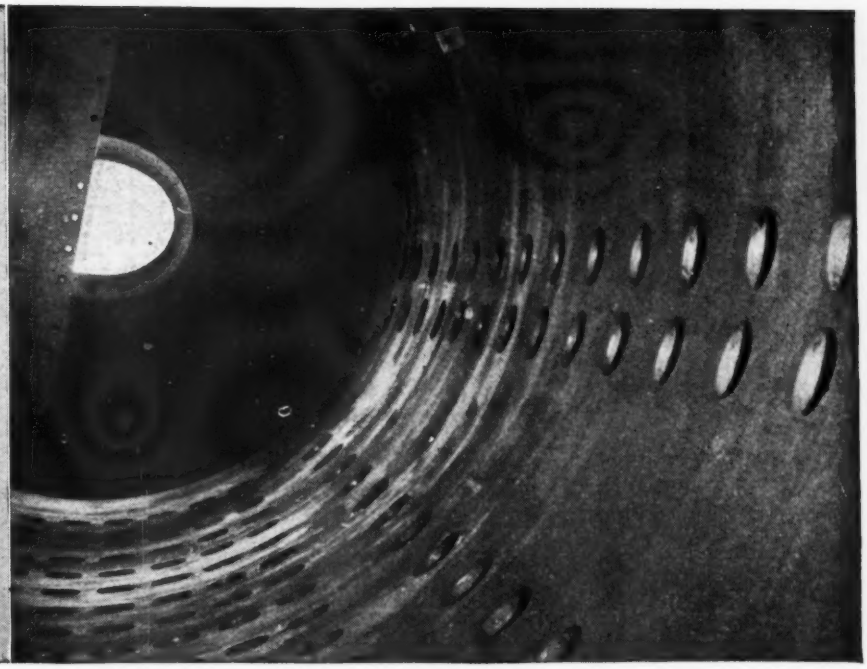
WRITE FOR BULLETIN 226-1 GIVING FULL SPECIFICATIONS, SIZES AND CAPACITIES

ARMY E NAVY

WARREN STEAM PUMP COMPANY INC.

Warren, Massachusetts

Scrap?... Reduce Pressure? ...No, APEXIORIZE!



APEXIOR GIVES BOILER METAL YEARS OF EXTRA SERVICE

Looks, fortunately, are often deceiving. Boilers that appear to be ready for the scrap pile or for operation at reduced pressure, have often been restored to good operating condition by APEXIOR. If they can pass inspection and a hydrostatic test, this long-lasting, corrosion-resistant, scale-resistant covering will "peg" that condition for more years of good performance.

APEXIOR seals up the pores and joints. It is applied with a hand brush or power coater after cleaning down to bare metal. One application lasts 2 to 3 years, and is easily renewed when worn too thin for protection. APEXIOR takes the wear . . . not the metal.

RECOMMENDED BY BOILER INSURANCE COMPANIES

Painting boiler metal is recommended by boiler insurance companies. Hundreds of industrial power plants, utilities, railroads and marine operators have been following their suggestions. And manufacturers of turbines coat shafts, rotor bodies and frequently interiors of casings with APEXIOR to lengthen the life of the metal and to facilitate its periodic cleaning.

So, before you start worrying about how to replace your aged equipment, have it tested . . . then APEXIORIZE if it passes the examination.

APEXIOR is a safe, sure answer to lack of new equipment . . . the solution to your problem of getting more out of your present equipment.

Save metal . . . extend time between boiler cleaning . . . make cleaning easier . . . APEXIORIZE.

Users like these have applied APEXIOR for years

It will help you get more service from irreplaceable equipment

The Solvay Process Co.
Ingersoll-Rand Co.
Puget Sound Power & Light Co.
Rockefeller Center, Inc.
Yale University
New York Central System
Chatham Manufacturing Co.
Pennsylvania Sugar Co.
Federal Shipbuilding & Dry Dock Company
Aluminum Co. of America
Allis-Chalmers Mfg. Co.

Ease of applying APEXIOR explained—Cleaning simplified. Write, today for Bulletin 1290 (Industrial) or 1305 (Marine) telling how to get peak production with peak protection.

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY of America**
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

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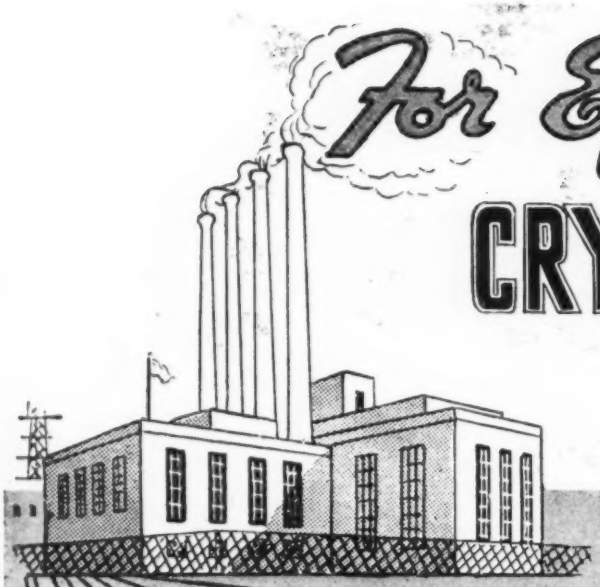
For Efficiency — CRYSTOLON Brick



DENSELY constructed of silicon carbide plus a highly refractory bond, and fired at high temperatures, CRYSTOLON Brick perform most efficiently under peak operating conditions. Their dense surface resists slag penetration, making clinker removal easy. They are unaffected by the corrosive action of coal ash slag and will not spall in elevated temperatures.

NORTON COMPANY
Worcester 6, Massachusetts

Norton Longer Lasting **Refractories**

BROWN
HIGH RANGE METER RECORDS & INTEGRATES FROM 25-100% OF CAPACITY
LOW RANGE METER RECORDS & INTEGRATES FROM 0-25% OF CAPACITY
3 CONDUCTOR CABLE
3 CONDUCTOR CABLE
HIGH RANGE METER BODY
LOW RANGE METER BODY
WIDE RANGE STEAM FLOW METER INSTALLATION

Ideal for WIDE RANGE FLOW

FOR metering steam where the flow varies over extremely wide ranges, the Brown Flow Meter System shown above, fulfills every requirement for high pressure steam heating and process loads.

The system consists of two meters connected to the same orifice. The low range meter records and integrates the flow from 0 to 25 per cent of maximum.

The high range meter records and integrates flows from 25 per cent to 100 per cent of maximums. The sum of both integrator readings gives the total steam flow. The change from one meter to the other is automatic and requires no manual operation.

Either or both meters can be supplied with auxiliary indicating scales and can be equipped with air control features in case it is desired to limit the maximum flow.

Brown Flow Meters are a guarantee of satisfaction to both the user and producer—for example, in the City of Washington, D. C., there are more than thirty stations where steam is measured by this practical method.

The Brown Wide Range Meter System is easily installed in large and small central distribution plants where accurrate accounting is a requisite.

Write for Catalog. THE BROWN INSTRUMENT COMPANY, **a division of Minneapolis-Honeywell Regulator Co.,** 4490 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—England: Wadsworth Road, Perival, Middlesex—Stockholm, Sweden: Nybrokajen 7.

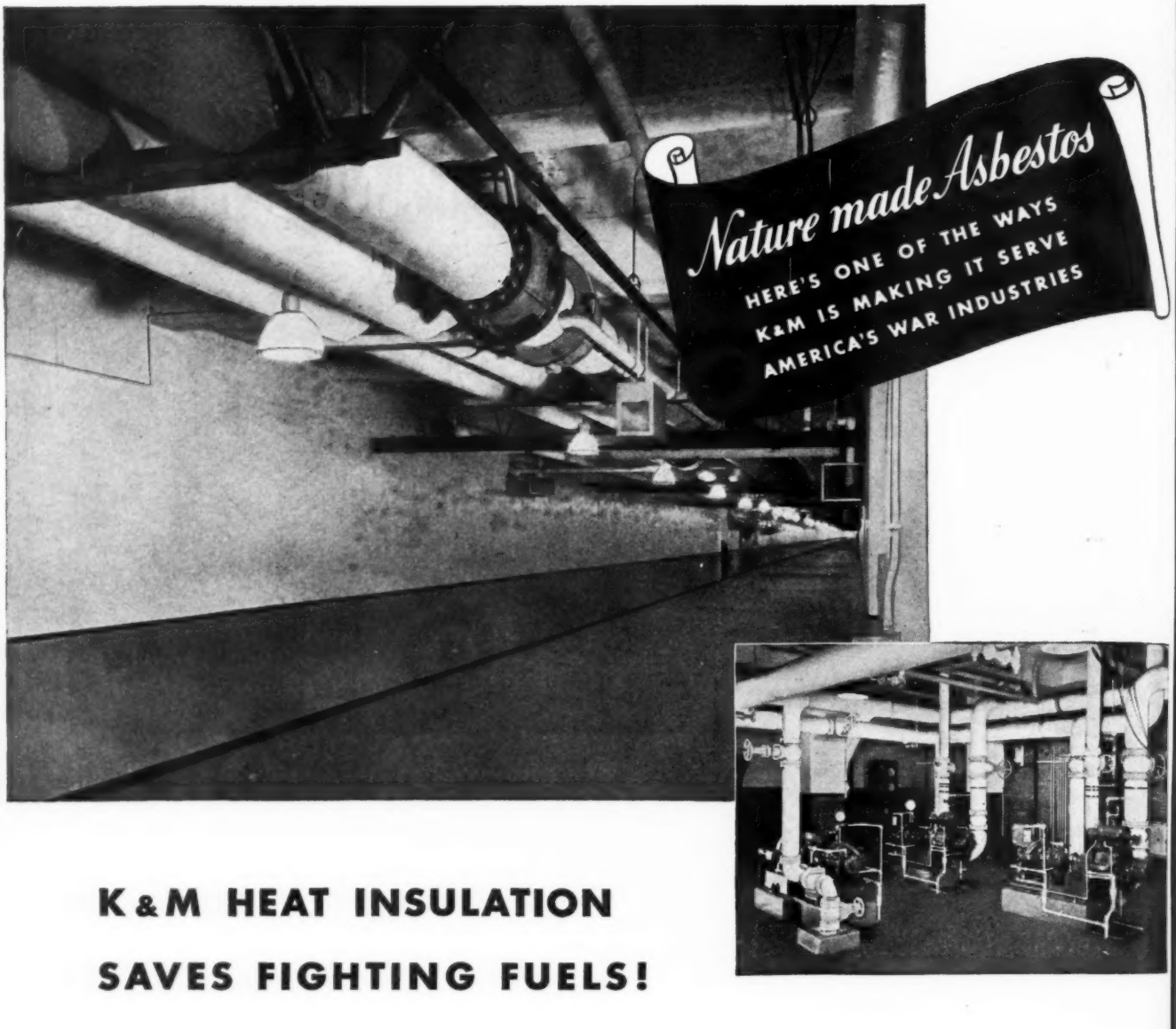
Operating Advantages

1. **Operates on the Inductance Bridge Principle! Inherently independent of voltage changes.**
2. **AUTOMATIC PLANIMETER PEN gives you a record on total flows over any period of time.**
3. **SIX INTERCHANGEABLE RANGE TUBES assure quick adjustment to changes in operating conditions.**
4. **INTEGRATOR DIAL. Easy to read. Simple counter — plain figures. Read it like your automobile mileage indicator.**

BROWN FLOW METERS

. . . MINNEAPOLIS - HONEYWELL CONTROL SYSTEMS . . .

To Measure and Control is to Economize



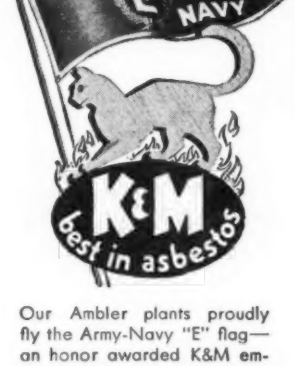
K&M HEAT INSULATION SAVES FIGHTING FUELS!

It takes plenty of steam—as well as gun powder—to fight this kind of a war. For example, here is a typical war plant which uses as much as 300,000 lbs. of steam per hour!

Throughout the power plant of this great factory, K&M Insulation is reducing heat loss . . . saving fuel and power . . . eliminating unnecessary expense.

K&M "Featherweight" 85% Magnesia reinforced with asbestos fibre, is recognized as one of the most efficient insulators ever developed. It's extra durable, too—undamaged by water or steam leakage. For temperatures up to 600 F., the efficiency, durability and economy of K&M "Featherweight" have never been surpassed.

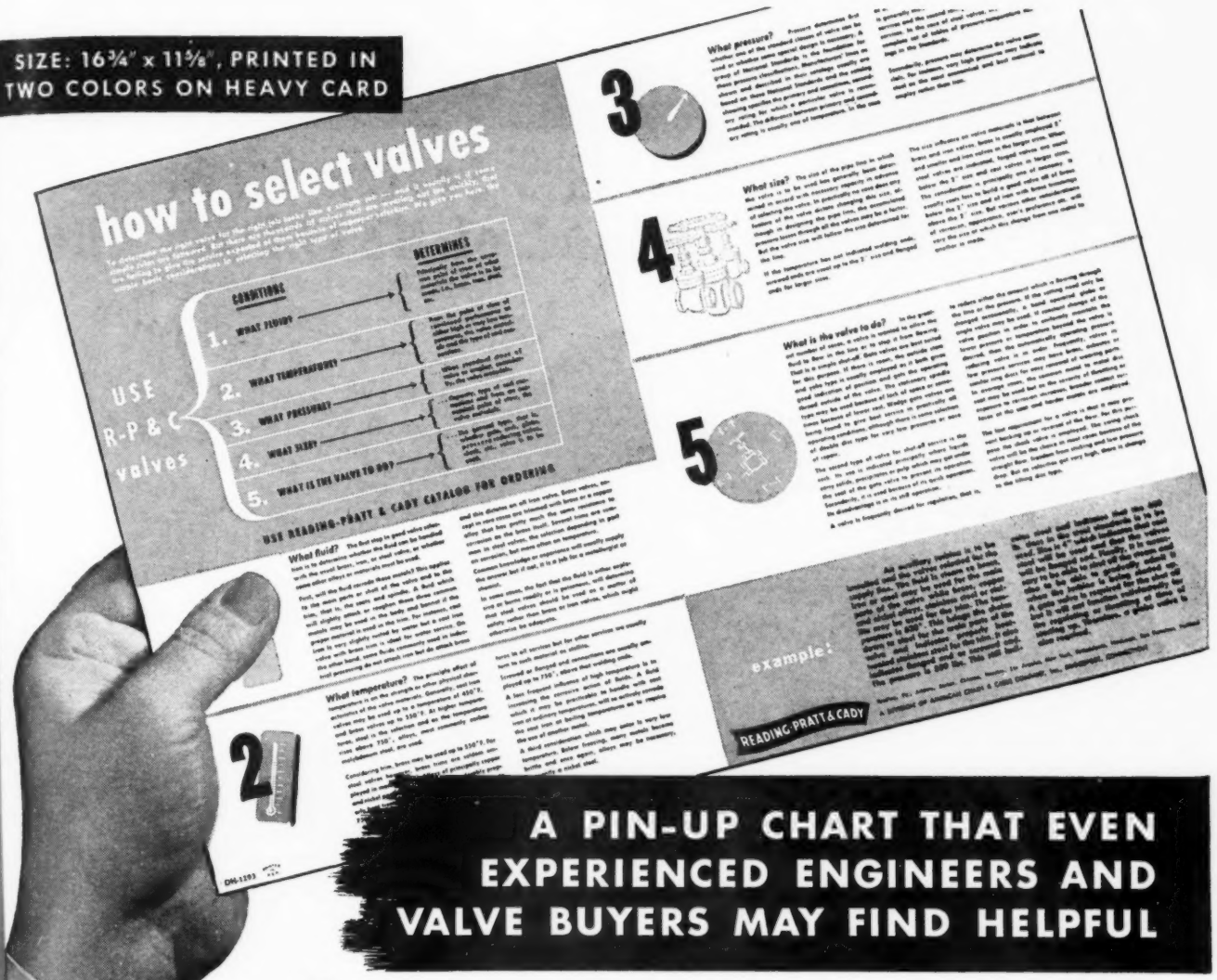
If you have an insulation problem in your plant, let Keasbey & Mattison, or an approved K&M distributor, help you solve it. Keasbey & Mattison know how to make asbestos serve new purposes—and serve the old ones *better!*



Our Ambler plants proudly fly the Army-Navy "E" flag—an honor awarded K&M employees "for outstanding production of war materials."

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

SIZE: 16¾" x 11⅝", PRINTED IN TWO COLORS ON HEAVY CARD

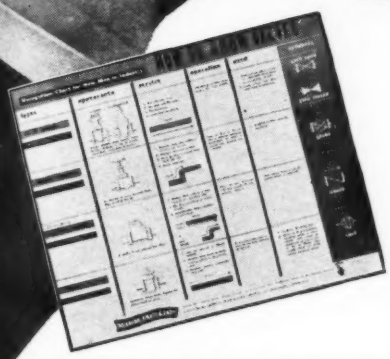


A PIN-UP CHART THAT EVEN EXPERIENCED ENGINEERS AND VALVE BUYERS MAY FIND HELPFUL

This easily read chart 16¾" x 11⅝" covers the 5 major considerations that determine the selection of valves.

1. **The fluid, from a corrosive standpoint, determines whether the valve should be made of brass, iron, steel, etc.**
2. **Temperatures, from the point of view of continued performance, determine valve materials and end connections.**
3. **Pressure determines the standard class to employ; and, secondarily, valve materials.**
4. **Size determines valve capacity, end connections and valve materials.**
5. **What the valve is to do determines whether to use cock, gate, globe, check, pressure-reducing valve, etc.**

This data is compressed into the READING-PRATT & CADY chart **"how to select valves."** Experienced men will find it an excellent prompter when they are discussing valves, and new men in industry will find its information an invaluable guide. Copy sent gladly. Address our offices in Reading, Pennsylvania.



HOW TO KNOW VALVES

A companion chart to **"how to select valves."** Tells how to identify quickly gates, globes, checks and cocks. Shows their distinct differences in appearance, the services to which each is suited, how each operates and where each should be used. Address Reading, Pa. office for a copy.

READING-PRATT & CADY

MANUFACTURERS OF

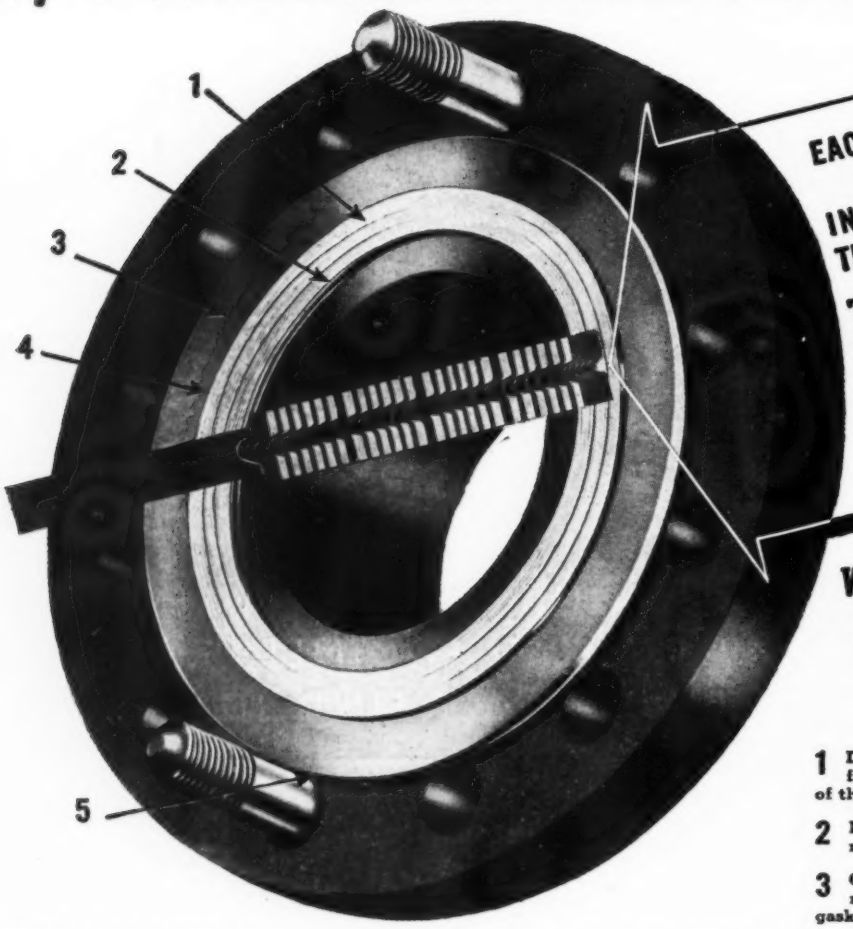
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT

FLEXITALLIC C-G GASKETS

High-Pressure Joints Sealed Tight by a CONTINUOUS SPIRAL of METAL ON EDGE



EACH TURN IN THE SPIRAL IS A BARRIER WHICH INTERPENETRATES WITH THE METAL OF THE FLANGES

This interpenetration of flange surfaces and the edges of gasket metal is the basic principle of gasket design pioneered by Flexitallic thirty-two years ago.

Think of a joint in a steam or other fluid line not as a static assembly but as a moving thing—expanding, contracting, vibrating. Think of the gasket in the joint as a moving member, capable of adjusting itself, always locked to the flange faces in millions of intergranular penetrations. Seen in this way, interpenetration is a starting point, a foundation on which to build a gasket structure.

But how keep the penetration when the flange faces move? In the design, which Flexitallic originated, the metal barrier is formed to provide an active spring, a semi-elliptic crease. The gasket stays with the flanges in every move they make.

How much barrier to provide? This is a vital point in the art. There must be enough to confine the fluid yet not so much as to offer too great resistance to compression and possibly cause overstress of bolts. Flexitallic gives the correct barrier for the specified conditions.

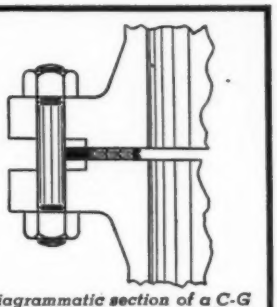
"Flexitallic" Reg. U.S. Pat. Office

And we make setting-up easy. These C-G gaskets with their gauge-ring save time.

Representatives in Principal Cities

With the principle of continuous edge penetration Flexitallic C-G Gaskets give you these other essential features

1. Density of the sealing member is modified in manufacture so as to be correct for the specified pressure of the line.
2. I.D. of gasket is clear of orifice at all points, offering no impediment in line.
3. Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.
4. Fit of surrounding ring, allows inner member to expand under compression.
5. Correct position assured by O. D. of gauge ring which fits inside of bolts.



Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.

FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.

Originators of Spiral Wound Construction

DOWELL INDUSTRIAL CHEMICAL CLEANING SERVICE

Increasing Industry's Productive Power

A quick—safe—efficient method of chemically removing water-deposited scales and sludge from all types of heat exchange equipment is provided by Dowell to help restore and increase industry's productive efficiency.

This proven chemical service is completely mobile and readily available at many strategic points.

The close cooperation between Dowell and its parent organization, The Dow Chemical Company, is fully utilized to provide industry with advanced methods and improved techniques in chemical cleaning.

Consult the nearest Dowell office for full information.

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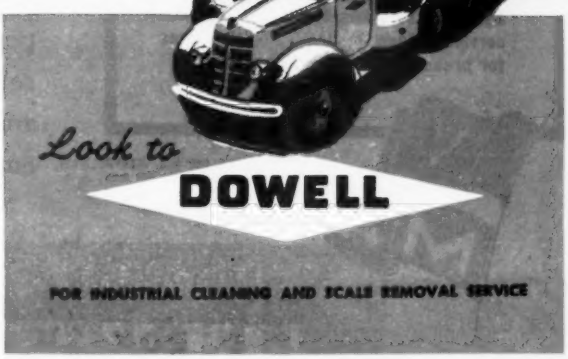


HOVALCO BOILER BLOW-OFF VALVES

Give DOUBLE SERVICE LIFE

Here's the Reason

DOUBLE LIFE
"Spare" seat and disc in every "Hovalco". Simply turn them over for good-as-new valve.

Cost 30% to 60% Less to MAINTAIN

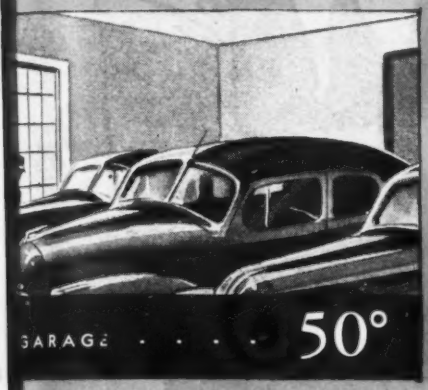
Hovalco Angle Valves used in combination with (1) Homestead Lever-Seald or (2) Cam Seald Quarter-Turn Valves meet the requirements of A.S.M.E. Code and all state laws for boiler blow-off service. Made in 1½"-2"-2½" sizes for pressures up to 600 pounds.

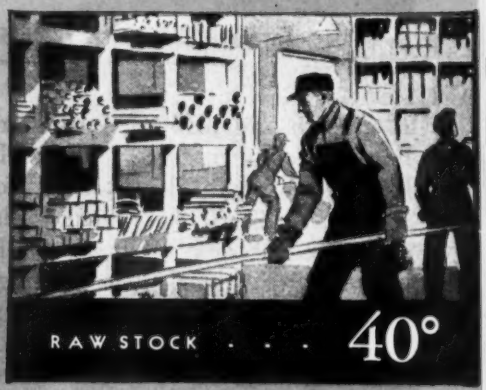
Maritime's two-flag, highest production award to our men and women making valves for the Victory Fleet.

Just turn over the ready-ground, perfectly matched, extra-long-wearing Monel Metal seat and disc of any Hovalco Angle Valve and you have a "good-as-new" valve ready to give *double* its length of service. Besides lasting more than twice as long as any ordinary valve, certified performance records from users show, Hovalco Blow-off Valves cost 30% to 60% *less* to maintain. You can meet today's demands for longer service, economy of operation and unfailing performance, by specifying Hovalco Blow-off Valves for renewals and in new installations. Select the proper size and type "Hovalco" for your condition from Valve Reference Book No. 38. Write for your copy today.

HOMESTEAD VALVE MANUFACTURING CO.

P. O. BOX 210 **CORAOPOLIS, PA.**





M-H FUEL SAVING CONTROLS

NOW AVAILABLE

FOR COMMERCIAL BUILDINGS!

WHETHER you divide a building into heating zones in accordance with occupancy demands or to compensate for outside weather conditions, or both, you not only conserve fuel but save money as well.

Minneapolis-Honeywell Zone Control equipment is now available for all types of commercial buildings, tailor-made to meet your individual requirements. Heat saved in low-temperature areas is used to heat those requiring higher temperatures. The cost of installation is nominal and will quickly pay out in fuel saved . . . Thus, you will be helping the war effort and saving money besides.

The Minneapolis-Honeywell branch in or near your city can quickly show you how easily you can obtain M-H Zone Control equipment. A fuel saving survey for your building, made by our engineers without cost or obligation, will show you the economy of Zone Control . . . Investigate at once . . . Call the Minneapolis-Honeywell branch office in your city or write Minneapolis-Honeywell Regulator Co., 2702 Fourth Avenue South, Minneapolis 8, Minnesota.

...ch the Attach—Buy **MORE** *War Bonds!*

MINNEAPOLIS **Honeywell**

CONTROL SYSTEMS

"It's not too difficult to get replacement parts --it's the lost time and nuisance of repairs that bothers us"

Engineers and plant operators from coast to coast have just confirmed the value of what Bigelow-Liptak has been doing for its customers for years. In a series of reports of interviews with plant operators and equipment users, conducted by a leading engineering journal, this remark kept coming back, "We don't have too much difficulty getting replacement or repair elements. It's the trouble, extra work and loss of time that hits us hardest." These men know the importance and economy of equipment that can be depended upon to give the service it is designed for, day after day.

This is exactly what Bigelow-Liptak engineers have always kept foremost in their minds when designing heat enclosures of all types. The availability of a boiler, oil still or billet heating furnace over a long continuous operating period is a vital part of the solution to the whole problem. It's the overall service and availability of the enclosure that counts.

A Bigelow-Liptak Engineer Is a Good Man to Know

With today's need for plant equipment that will stay in operation, you need expert counsel more than ever in discussing your industrial furnace enclosures. The list of companies for which Bigelow-Liptak has designed enclosures reads like a Who's Who in American Industry. In the long list are included every type and size of enclosure in which thermo-dynamics, ceramics and mechanics of materials are factors.

It will pay you to discuss your heat enclosure problem with Bigelow-Liptak—if you want enclosures that will give service and economy over a long continuous operating period.

Get in touch with a Bigelow-Liptak engineer.

Who is Bigelow-Liptak?

Bigelow-Liptak develops and designs heat or furnace enclosures—enclosures that are individually engineered for the user's own needs—not toward the false economy of a low initial cost—but to provide long, dependable service and economy of operation.

Enclosures for your industrial furnaces are the parts most subject to wear and tear. They enclose the combustion which is the working force of the particular heat machine involved—and as such their length of satisfactory service (availability) determines the effectiveness of the furnace itself.

BIGELOW-LIPTAK

BIGELOW LIPTAK Corporation

Unit-Suspended Walls & Arches

BIGELOW-LIPTAK CORPORATION
DIVISION A. P. GREEN FIRE BRICK CO.

330 Curtis Building — DETROIT 2, MICHIGAN

A Unit-Suspended Wall & Arch for Every Furnace

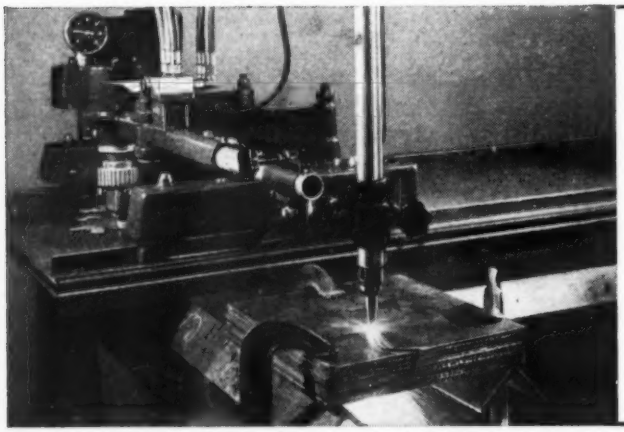
dimensional accuracy makes ⟨S⟩ worth looking for!

Years ago, Sivyer determined that Sivyer Steel Castings would merit a reputation for dimensional accuracy. Hence we go beyond usual foundry practice in checking all castings for correct size, shape and contour. Users of Sivyer Castings find this means less processing—less handling—getting castings on the job faster. That's one of the big reasons why the Sivyer ⟨S⟩ is worth looking for.

SIVYER STEEL CASTING COMPANY
MILWAUKEE ⟨S⟩ CHICAGO ⟨S⟩

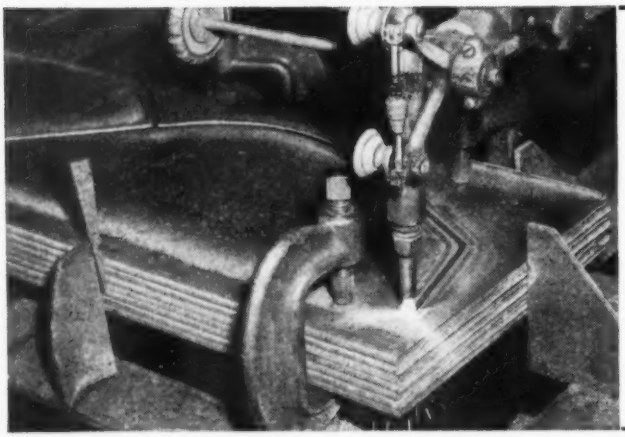
ARMY E NAVY

OXY-ACETYLENE STACK-CUTTING Quickly Produces Identical Parts from Stock Steel



1. What it is

Oxy-acetylene stack-cutting produces quantities of identically shaped parts from clamped piles of steel plates or sheets. Steel ranging in thickness from 16 gage to 1 inch can be cut with good results —in piles as thick as 5 inches. If the plates are correctly clamped, the cut edges are clean and smooth. Stack-cutting can be done with either portable or stationary flame-cutting machines. In the illustration at the left, an Oxweld cutting blowpipe is slicing through 8 plates, each ¼-in. thick.



2. How it saves

Oxy-acetylene stack-cutting produces needed parts from stock steel quickly, and usually at lower cost than parts already shaped can be obtained. Stack-cutting is usually a faster and cheaper method than shaping single parts by mechanical means, and it also helps to conserve steel because it reduces scrap losses. Additional savings result when machining operations are done on the flame-cut stacks before the parts are separated. The uniformity of stack-cut parts facilitates fabrication and assembly.

3. Linde can help you use it

Linde can help you determine where and how you can profitably use Oxweld flame-cutting equipment for the shaping of parts by stack-cutting. In addition to supplying the oxygen, the acetylene, and other essential materials, Linde also makes available to its customers, motion picture showings, how-to-do-it literature, and other services that help operators do a consistently good stack-cutting job.

MARITIME "M" AWARD FOR OUTSTANDING PRODUCTION ACHIEVEMENT

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD APPARATUS . . . OXWELD SUPPLIES

The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," and "Prest-O-Weld" are trade-marks.

Everywhere it's **S-A** *Specialized Engineering*

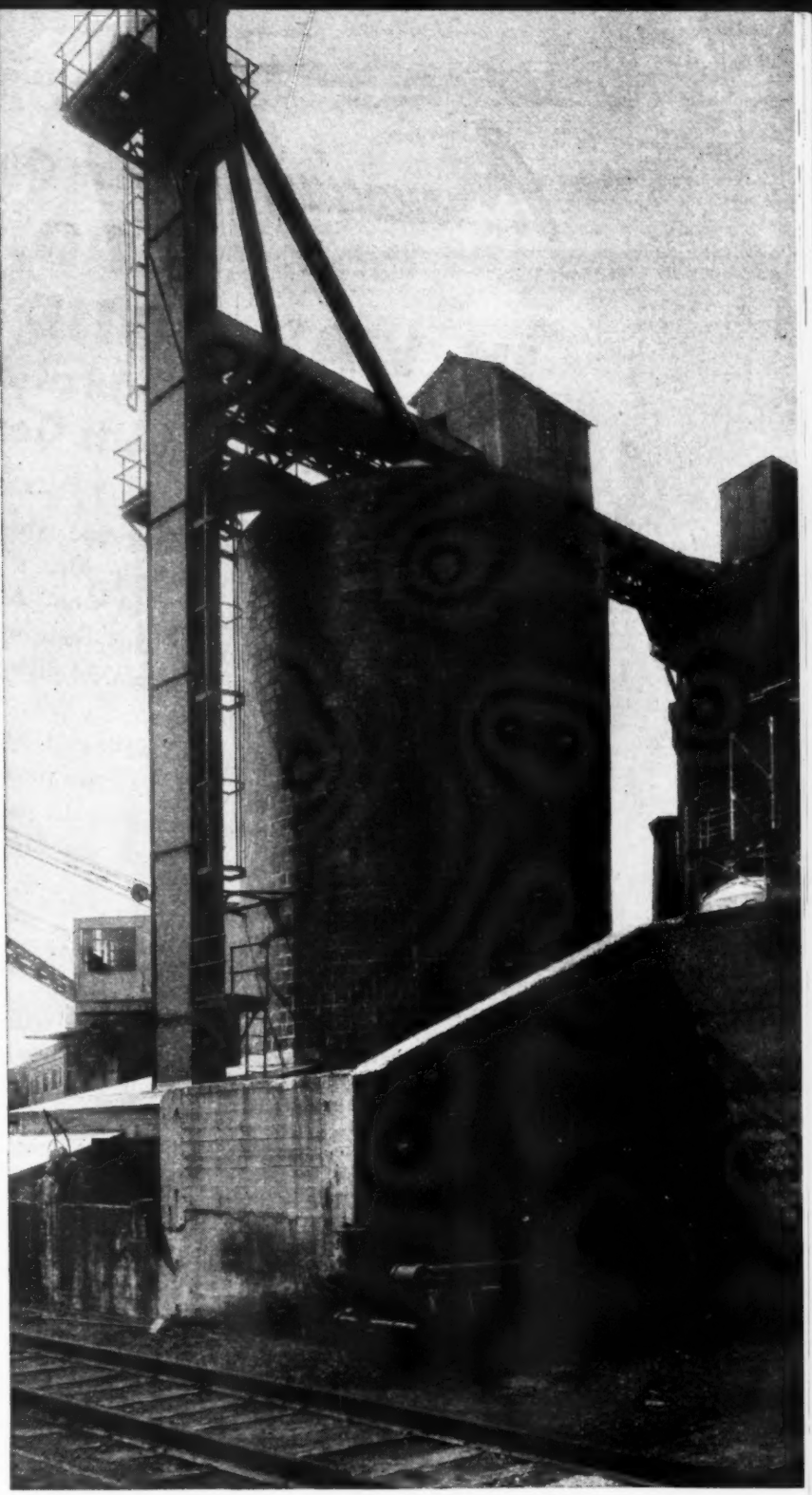
Examples of efficient Stephens-Adamson coal elevating and conveying systems are found in power plants, large and small, throughout the country.

Each installation presented individual problems which had to be solved and special conditions which had to be met before the lowest possible handling costs were assured.

Each installation was planned by S-A Engineers, long experienced in the design of efficient, economical Coal Handling systems, and put into operation by conveyors, elevators, feeders, etc., selected from S-A's complete line of manufactured handling units.

S-A recommends the *right method* and furnishes the *right equipment.*

Consult us now on your plans for improving or expanding your coal handling system.



This S-A system features a double track hopper and a pan feeder feeding coal to a double roll crusher. Bucket elevator elevate coal to 2-way discharge spout to send coal either to boiler house via belt conveyor or to storage silo for later reclaiming.

STEPHENS-ADAMSON MFG. CO.

RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

Announcing: THE MARSH GAUGE OF PUBLIC OPINION

$2,000.00 IN WAR BOND AWARDS

for the most accurate prediction of when the war with Germany will end

ANXIOUS times, these! Everyone who thinks, has a fairly definite idea of when and how the victory will be won. As our contribution to keeping this winning spirit alive we make the awards listed above. You simply predict when the "shooting war"* with Germany will end and briefly state the reason for your prophecy. The most accurate prediction gets the capital award and so on through the fifteen awards listed opposite.

FIFTEEN AWARDS

First Award
$1,000.00 BOND

Second Award
$500.00 BOND

Third Award
$200.00 BOND

Twelve Awards of
$25.00 BONDS

Get Official Entry Blank from your jobber

CONTEST BRIEFS

- Entries must be postmarked on or before midnight July 31.
- Anyone except members of our organization and their families may enter.
- In case of ties, awards equally divided.
- If war ends before contest closes only prophecies postmarked 48 hours before official end will be considered.

(All details are given on your official entry blank)

To simplify procedure, predictions are accepted only when made on Official Entry Blanks. The blanks give complete details and answer all questions about the contest. No one, except members of our own organization and their families, is barred from competing, so ask your jobber or write us for blanks (only one per person) and give us your prophecy. Remember: Contest closes July 31! Entries must be postmarked on or before midnight July 31, 1944.

Important: To be acceptable, entries must be mailed to

JAS. P. MARSH CORPORATION
2075 Southport Avenue, Chicago 54, Illinois

*By "end of shooting war" is meant the precise time, as officially determined by the U.S. Government, of the signing of an armistice or other agreement stopping all hostilities with the then constituted German Government. (If there is a resumption of hostilities this will be considered a *new* war.)

The Gauge with the "RECALIBRATOR"

A gauge of Marsh quality is not likely to be knocked out of adjustment. But if it is the Marsh "Recalibrator" will quickly restore its accuracy. Simply turn the "Recalibrator" screw until the pointer is at zero when not under pressure. The gauge will then be right at all points on the dial.

© Jas. P. Marsh Corp.

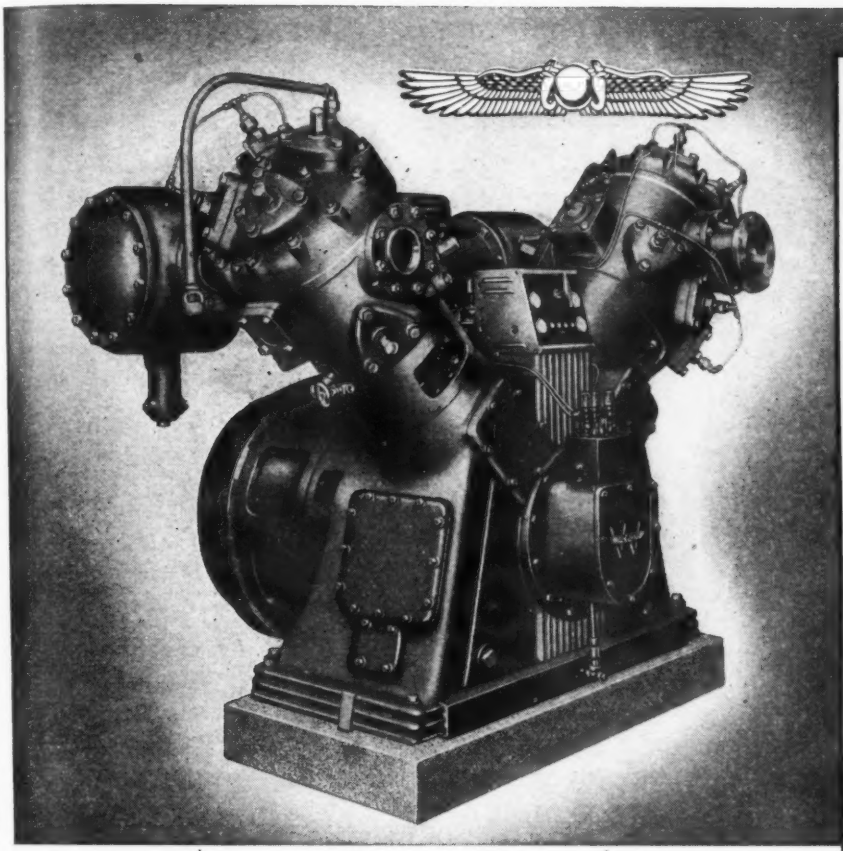
MARSH GAUGES

DIAL THERMOMETERS

"THE STANDARD OF ACCURACY"

HEATING SPECIALTIES

NEW WORTHINGTON HUSKIE PACKAGED COMPRESSORS



The simplest, lightest, most efficient compressor valve ever made. A thin strip of steel seats by increasing contact from each end to the center. No springs, buffer plates or cushioning devices. Fits accurately even when valve seat is warped, and patented end inserts prevent pinching.

For Cooler Running . . . Trouble-Free Operation

Here's a lot of long-lived power, from 400 to 1350 cu. ft. per minute displacement, in a new streamlined "package" specially designed for trouble-free operation, low installation and maintenance costs.

In both 3 and 5-step models, variable capacity control results in the *cooler operation* of Worthington's new Y Angle Type Huskie Compressors. Cylinders are open to cool suction air at most stages of unloading.

Other Worthington "Outperformance" features include Feather Valves*— forced feed lubrication — filters for uninterrupted oil filtration, non-stop filter-cleaning. Write for more details. Describe your application.

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, N. J.

WORTH BEHIND THE NAME WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON HUSKIE

Y Type . . . Horizontal . . . Vertical . . . Radial . . . Portable . . . Gas Engine Compressors . . . Vacuum Pumps

*Reg. U. S. Pat. Off.

AC4-4

What NAVCO means to Piping

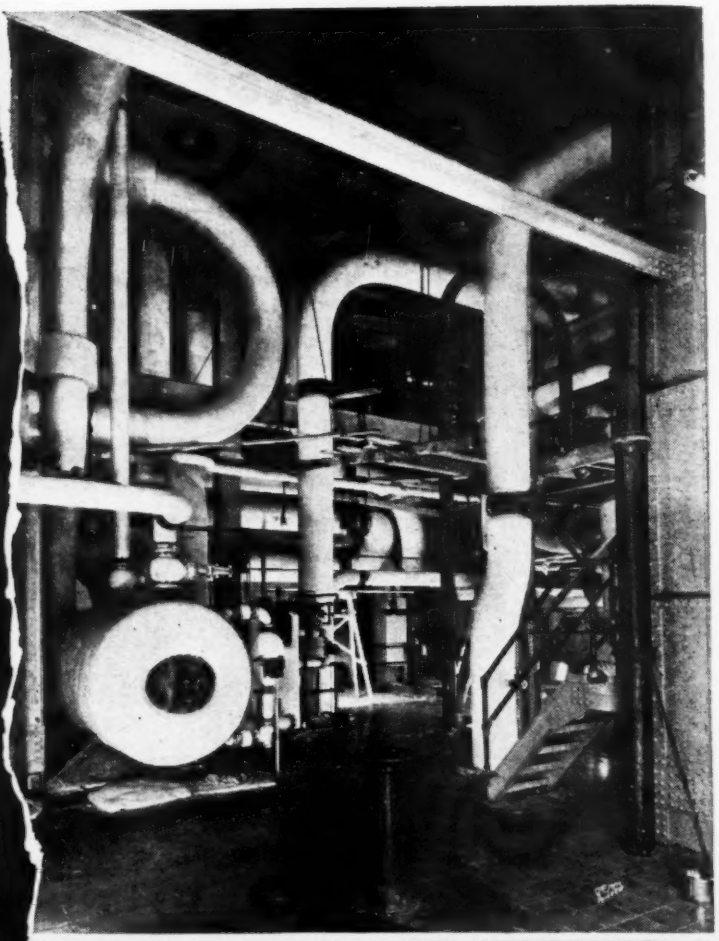
SKILLED ENGINEERING
CORRECT DESIGN
MODERN FABRICATION
ACCURATE WORKMANSHIP

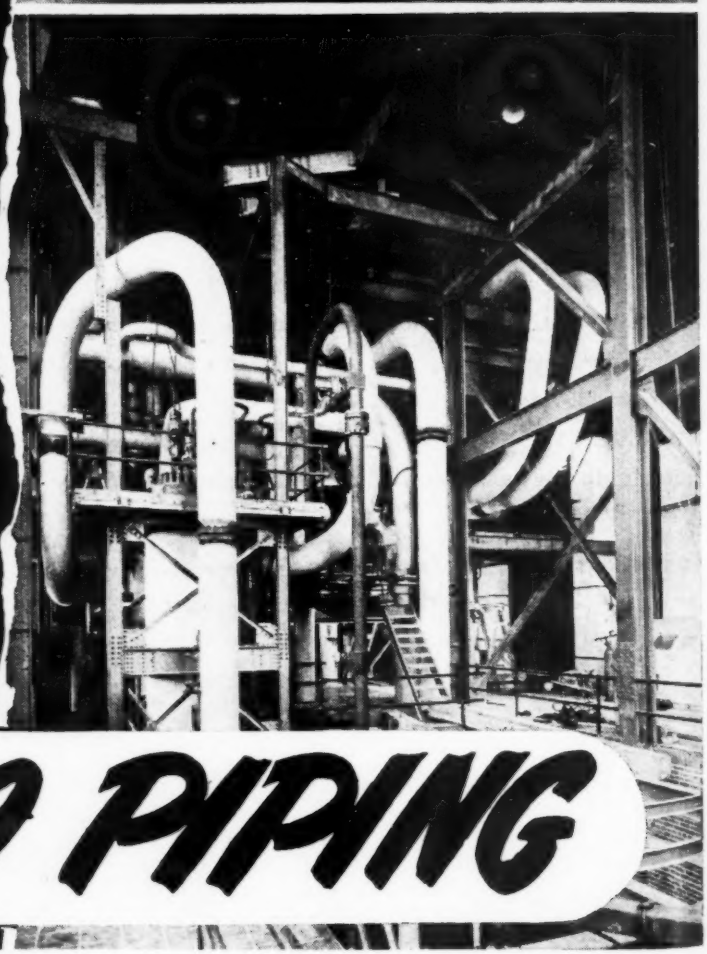
•

A background of 36 years experience in engineering and designing, in addition to employing the most modern methods available, are your assurance of obtaining highest quality materials and workmanship.

For your piping problems,
consult Navco

NATIONAL VALVE & MFG. CO.
PITTSBURGH, PA.





NAVCO

NAVCO PIPING

CLARAGE
ENGINEERS KNOW HOW

NO INSTALLATION DELAYS — Whole Works In One Compact Assembly!

Clarage Multitherm Units can step up your production, and insure lower post-war costs. Units are made for cooling only, heating only, or complete year 'round air conditioning. Quickly installed without expensive building alterations; no ducts required. Space-saving, suspended type unit shown above.

SPECIAL SERVICES

Back of our field engineers are design specialists, research and testing laboratories. We are geared to solve any air handling or conditioning problem, no matter how special.

INVEST IN VICTORY:
Buy More War Bonds!

Too much or too little heat, too much or too little humidity, smoke, fumes, foul odors — are *BAD* air conditions keeping your production low, costs high — giving your plant an acute absentee problem?

★ Possibly it's time to have a Clarage application engineer give your operations the once-over — have him spot your air handling or conditioning needs. *HE KNOWS HOW!* You'll like his intelligent, forthright answer to your requirements.

★ You'll like, too, the way we at the factory do our part to back him up by furnishing equipment engineered for high efficiency, and built for unfailing service. Our total and unexcelled facilities are at your command!

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

Clarage Fan Company Kalamazoo, Mich.

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

Scale-smashers by ELLIOTT

This group of aids to boiler health is a small part of many now in service on Maritime Commission vessels. These cleaners, all water-driven, are for 2 in. and 4 in. tubes. The larger cleaners are equipped with universal joints for use in curved tubes.

Afloat and ashore, Elliott tube cleaners are at their best in any tube that can be cleaned. They combine powerful motors, armed to the teeth with tough, hard, trackless cutters in cutter heads that will stand the gaff of heavy service. They are the final up-to-the-minute word in scientifically designed tube cleaning equipment, developed through many years of research and experience.

If you have a tube cleaning problem, Elliott has the tool for it and the experience to back it up. Write us.

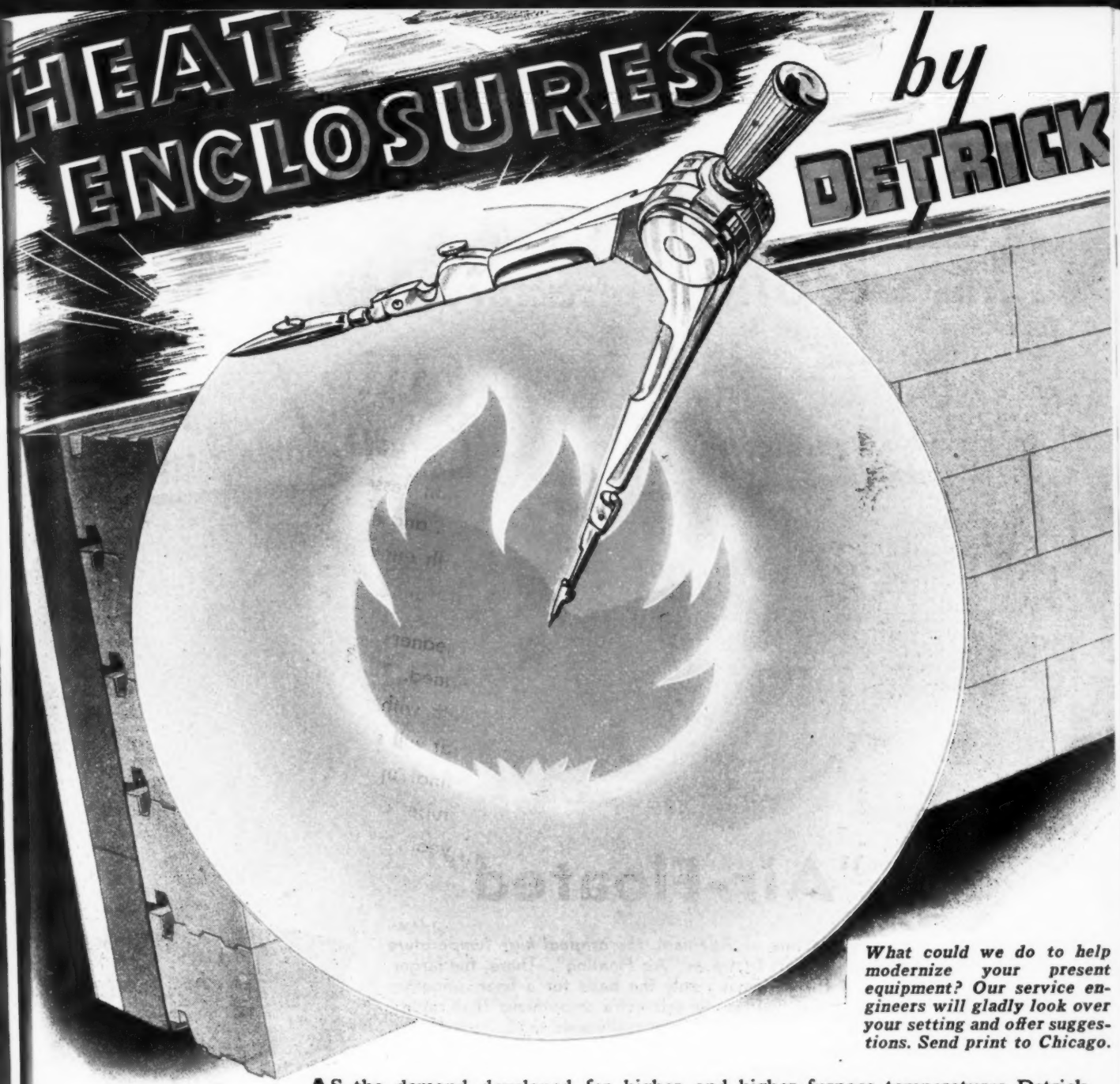
ELLIOTT COMPANY
TUBE CLEANER DIVISION, SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

Elliott cleaners

for tubes of every kind, everywhere

Y-219

HEAT ENCLOSURES *by* DETRICK



What could we do to help modernize your present equipment? Our service engineers will gladly look over your setting and offer suggestions. Send print to Chicago.

Detrick Plastic Casing applied with a trowel fits closely in place against the insulation and provides a tight, weatherproof covering which is also neat in appearance.

As the demand developed for higher and higher furnace temperatures Detrick engineers, in at the beginning, have kept the pace offering improved construction and material application. Refractory furnace walls and arches have been designed to withstand high capacity conditions. The next step was insulated walls and arches to stop heat flow and now we have plastic casing which can be applied with a trowel which protects the insulation and gives a weatherproof finish. Each of these steps have been worked in a design that provides a maximum of effective life and a minimum annual cost.

The principles learned in nearly a third of a century of engineering furnace enclosures have been described in a new book which illustrates these principles as applied to many types of furnaces. Engineers who wish to bring themselves up to date on this important subject should have a copy of this book which will be sent on request.

M. H. DETRICK COMPANY, 111 West Washington Street, Chicago 2, Illinois

DETRICK FURNACE ENCLOSURES

USE DETRICK INSULATION PLASTIC or BLOCK

ADAMANT
FIRE BRICK CEMENT

...the SMOOTHER refractory material

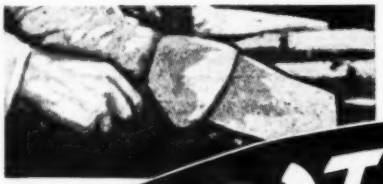
It's "Air-Floated"

In one stage in the manufacture of Adamant, *the original high temperature cement*, it passes through a process known as "Air Floating". There, the larger, coarser particles are dropped out, leaving only the basis for a finer, smoother cement. Because of the greater uniformity and extra smoothness that results, the preferred thin joints are possible . . . joints that really weld the brick together.

Another outstanding advantage of Adamant is its exceptionally high bonding strength. This fact has been attested by impartial laboratory tests conducted by a leading technical institute. These showed that *Adamant has a bonding strength of 800 lbs. per sq. inch at room temperature; 1270 lbs. per sq. inch at 2600°F.* Adamant has a P. C. E. of 3000°F. plus.

The strong, thin joints made with Adamant are an assurance of longer lasting furnace linings and savings in maintenance costs, for Adamant joints are strong as the brick they bond. Provide this extra strength in your furnace linings where it is needed most . . . at the joints where brickwork failure generally begins.

For greater convenience Adamant is shipped ready to use in 100, 250 and 500 lb. drums.



Adamant, the *original* high temperature Fire Brick Cement and the complete line of Adaproducts, including also Adahearth, for forming monolithic hearths . . . Adacast, for making special fire clay shapes . . . Adapatch, for patching walls, checking deterioration . . . are carried in stock by distributors in principal industrial centers. Write for the name of the Adaproduct distributor nearest you.

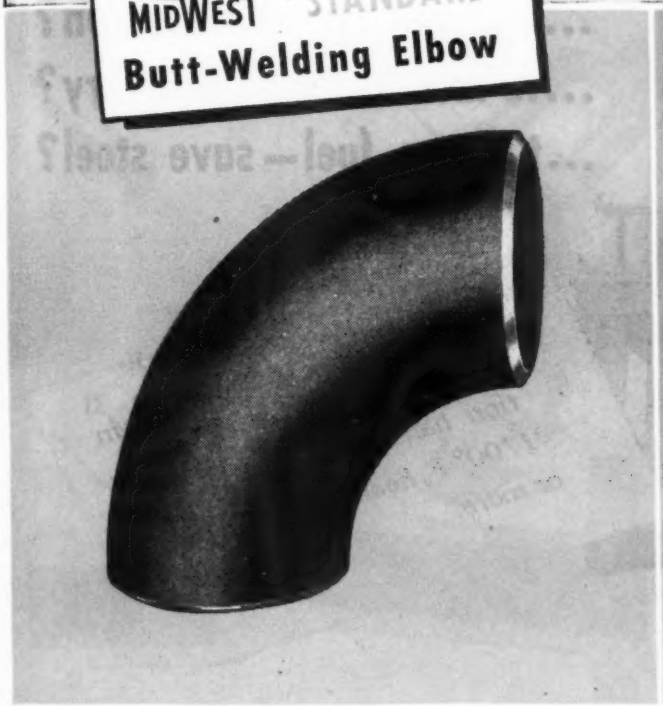
BOTFIELD
REFRACTORIES CO.

784 SOUTH SWANSON ST., PHILA. 47, PENNA.

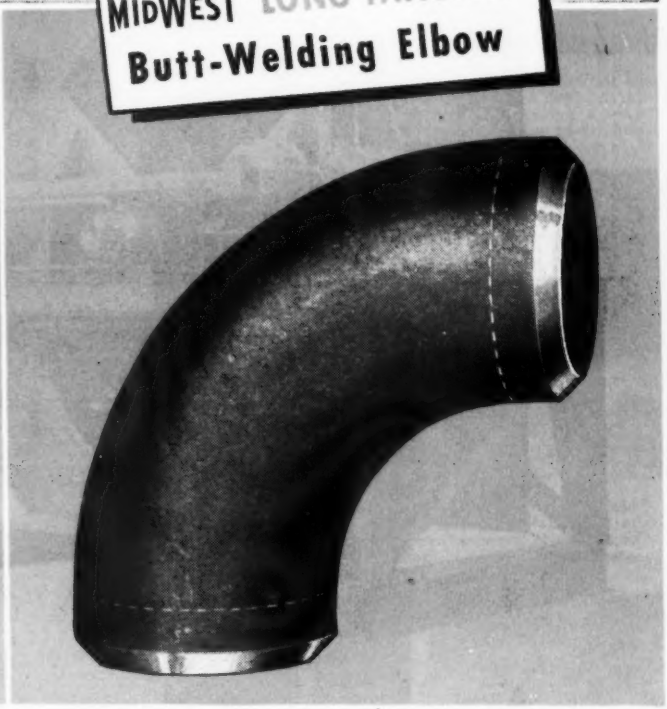
In Canada; Canadian Botfield Refractories Co. Ltd., 171 Eastern Avenue, Toronto

Only MIDWEST OFFERS YOU THIS CHOICE

MIDWEST "STANDARD" Butt-Welding Elbow



MIDWEST "LONG TANGENT" Butt-Welding Elbow



The difference between the two types of welding elbows shown above is in their dimensions. The "American Standard" elbow has a center-to-end dimension equal to one and one-half times the nominal pipe size. The Midwest "Long Tangent" elbow has tangents (straight ends) equal to one-fourth of the nominal pipe size; the center-to-end dimension is one and three-quarters times the nominal pipe size. Important among the advantages of the long tangents are: (1) pipe and fitting more quickly and accurately lined up, (2) weld removed from point of maximum bending stress, (3) less pipe required, (4) short nipple and extra circumferential weld frequently eliminated, (5) slip-on welding flanges easily used, etc. There is no increase in price for Midwest "Long Tangent" Welding Elbows.

Both types of elbows have all other advantages that result from the unique Midwest manufacturing process: final working of metal in compression (which means exceptional dimensional accuracy and uniformity), stress relieving, exact included angle, true circular cross-section and uniform wall thickness. For all the facts about Midwest Welding Fittings, ask for Bulletin WF-41.

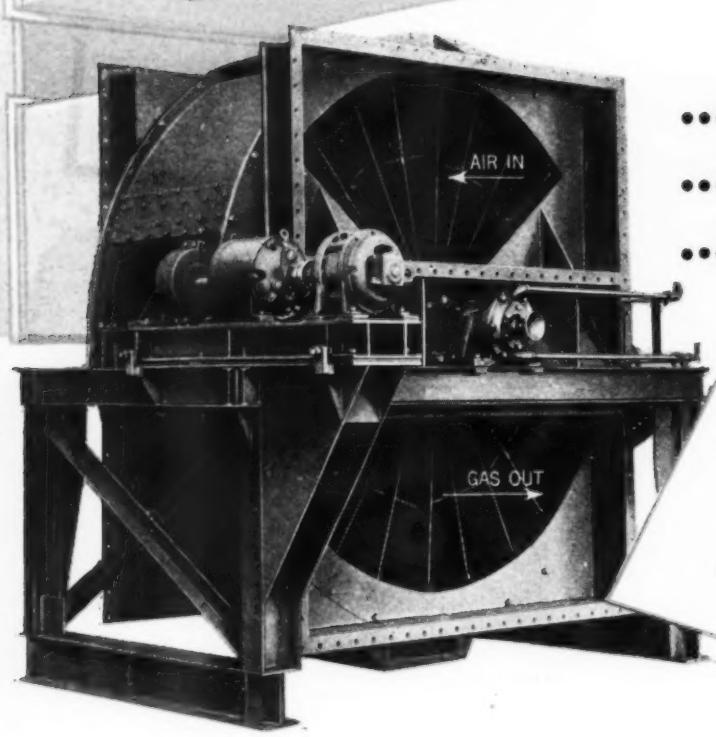
MIDWEST PIPING & SUPPLY CO., INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.

Can You Use AIR AT 1000° F



...to improve combustion?
...to increase heat recovery?
...to save fuel—save steel?

LJUNGSTROM *Air Preheaters in high-temperature construction handle hot gases up to 1700° F, heating air to 1000° or more.*

WARTIME DEMAND FOR CONSERVATION has given impetus to heat-recovery at higher temperatures than normally encountered in steam generating plants. Applied to cracking-still furnaces, for example, they may permit reduction or elimination of the convection tube bank, after the gas leaves the radiant section. Applied to roasting furnaces, they can increase combustion temperatures to maintain efficient furnace conditions.

OUR EXPERIENCE IN PRE-HEAT ENGINEERING at these high-temperature conditions, offers real benefits to you, whatever the temperature-range of your installation. Thermal and mechanical problems solved for 1500° jobs add to service continuity and long life at more conventional temperatures.

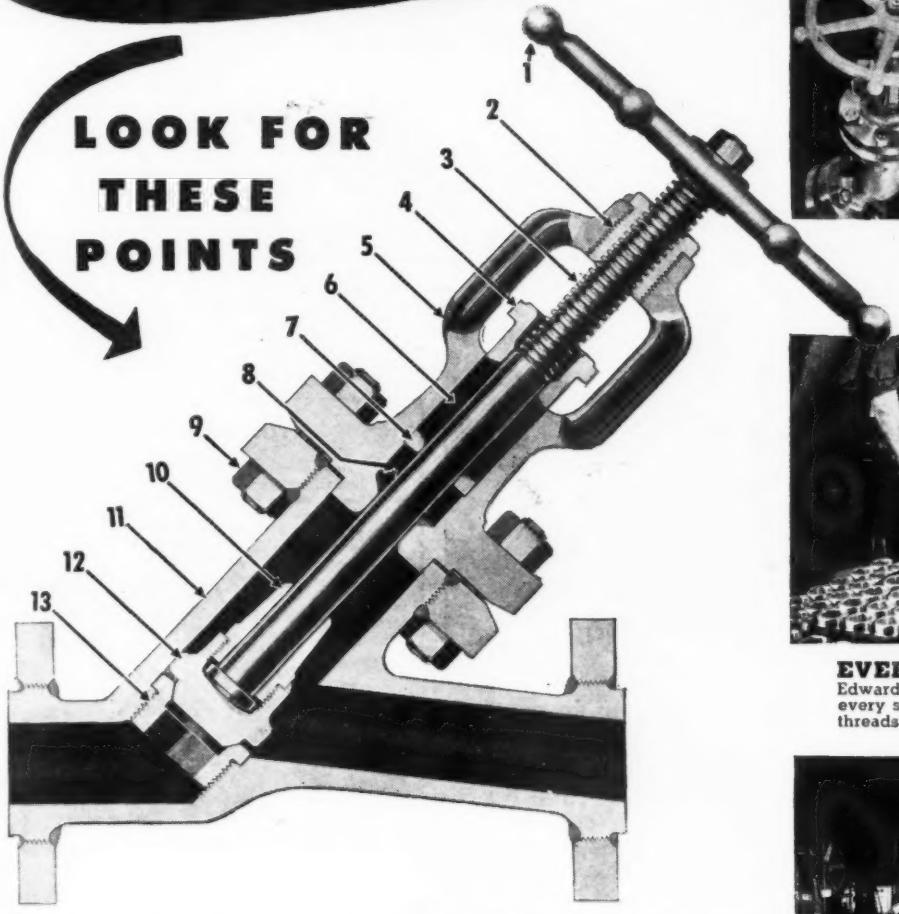
LEADING BOILER MANUFACTURERS AND CONSULTANTS are prepared to incorporate Ljungstrom Air Preheaters as an integral part of high-efficiency furnace design. Leading oil refinery engineers regularly specify their use. Our staff will work closely with you in applying pre-heat to new or unusual problems requiring gas-to-air heat transfer. For further information write:

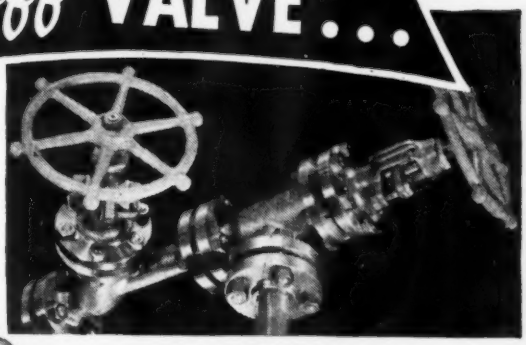
THE AIR PREHEATER CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y.

NUMBER TWO OF A SERIES ON VALVE SELECTION

How to buy a *Blow-off* VALVE...





FIT ANY SPACE. Edward steel blow-off valves are built in both straight-way and angle design, offering a variety of hookups to fit installation space needs.

EVERY-STAGE INSPECTION. Rigid Edward inspection procedures check all parts at every stage of manufacture. Inspector above gages threads of wear resistant EValloy valve seats.

FORGED. Drop hammers forge many parts of Edward blow-off valves for top strength in hard usage.

SYMMETRY. Fine-finish, perfect symmetry of EValloy stems is achieved by centerless grinding.

BORIZED. Mating blow-off seats and disks are precision borized at exact angles in same operation.

WELDING ENDS. Socket welding ends, as well as flanged ends, are available in Edward blow-off valves.

1 Handwheel. Strong, knobbed, easy to grip even with wet hands. Oversize dimensions make operation easier.

2 Yoke Bushing. Bronze. Completely machined in one set-up so internal and external threads are perfectly concentric.

3 Stem. EValloy stainless steel with low coefficient of expansion to prevent loosening in cooling.

4 Gland. Forged steel, smoothly machined to prevent binding or scoring.

5 Bonnet. Forged steel, integral yoke post design to prevent misalignment.

6 Packing. Die formed temperature resisting EValpak.

7 Junk Ring. Accurately fitted to stuffing box.

8 Cooling Chamber. Large condensate chamber to protect packing.

9 Studs and Nuts. Through bolted joint makes disassembly simple.

10 Disk Nut. Heavy steel with backseating surface for repacking under pressure.

11 Body. Streamlined steel body with no unnecessary parts to clog or erode.

12 Disk. EValloy stainless steel or Stellite hard facing, precision borized with mating seat.

13 Seat. EValloy or integral Stellite seat, mated with disk.

Built in three pressure classes—300 lb., 600 lb. and 900-1500 lb. sp.

NEW! Catalog 12-D covering Edward blow-off line soon off the press. Write for your copy today.

THE EDWARD VALVE & MFG. CO., INC., • EAST CHICAGO, INDIANA

EDWARD *Steel* VALVES

A Single Cardox System Provides Engineered Extinguishing Coverage for One or a Number of Hazards . . . Large and Small

The swift efficiency of carbon dioxide for fire extinguishment is thoroughly recognized. But, where a few pounds, properly applied, will stop one fire, another may call for tons . . . for example, to provide total flooding of large plant production areas, or for severe outdoor hazards.

With the Cardox method of control and engineered application, Cardox CO_2 —supplied instantly *in pounds or tons* —gives new protection scope to this non-damaging, non-contaminating medium for fire extinguishing.

Enhanced CO_2 Performance

A Cardox System—engineered for the specific hazards it covers—extinguishes fires by a timed *mass* discharge of Cardox CO_2—stored at 0°F. in a mechanically refrigerated Storage Unit.

Enhanced extinguishing performance is possible because, as controlled and applied—*in pounds or tons*—in Cardox Systems: (1) Cardox CO_2 has uniform extinguishing characteristics regardless of plant or atmospheric temperatures; (2) Applications can be engineered in accordance with the requirements of each specific hazard covered; (3) High CO_2 snow yield provides increased cooling effect (carbon dioxide released at 0°F. yields 45% CO_2 snow); (4) Effective projection through relatively great distance is achieved—even outdoors.

Tough Hazards Have "Engineered" Cardox Systems

It is no coincidence that frequently when hazards are toughest to handle . . . where fire or damage by the extinguishing medium would disrupt carefully planned war goods production schedules . . . engineered protection is provided by Cardox Fire Extinguishing Systems.

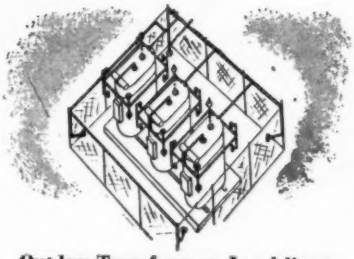
If you would like more information for use in solving current war plant fire protection problems . . . or in formulating fire protection plans that will prevent dangerous delays in getting post-war production in high gear . . . write on company letterhead for Bulletin 9.

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS
District Offices in
New York, Boston, Washington, Detroit, Cleveland, Atlanta, Pittsburgh, San Francisco, Los Angeles, Seattle

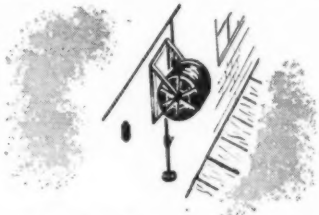
CARDOX
CO_2 FIRE EXTINGUISHING SYSTEMS

FOR EXAMPLE

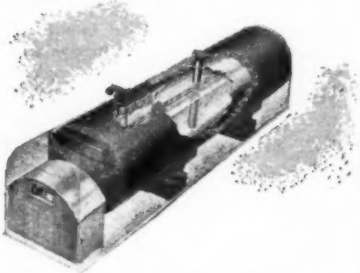
These sketches illustrate simply the broad scope of protection that can be provided by a *single* Cardox System. The range of efficient applications between these extremes is practically unlimited.



Outdoor Transformers. Local direct application at very high rate builds area flooding effect outdoors. For hazards such as this a Cardox System stands ready at the first flash of fire with *tons* of Cardox CO_2, if needed.



Cardox Hose Reel provides effective protection for numerous hazards calling for a *few pounds* of Cardox CO_2—or a *few hundred.*



Cardox CO_2 is supplied instantly in pounds or tons from a single Storage Unit containing 500 pounds to 125 tons at controlled low temperature of 0°F. and 300 p.s.i.

Mechanically right—hydraulically efficient

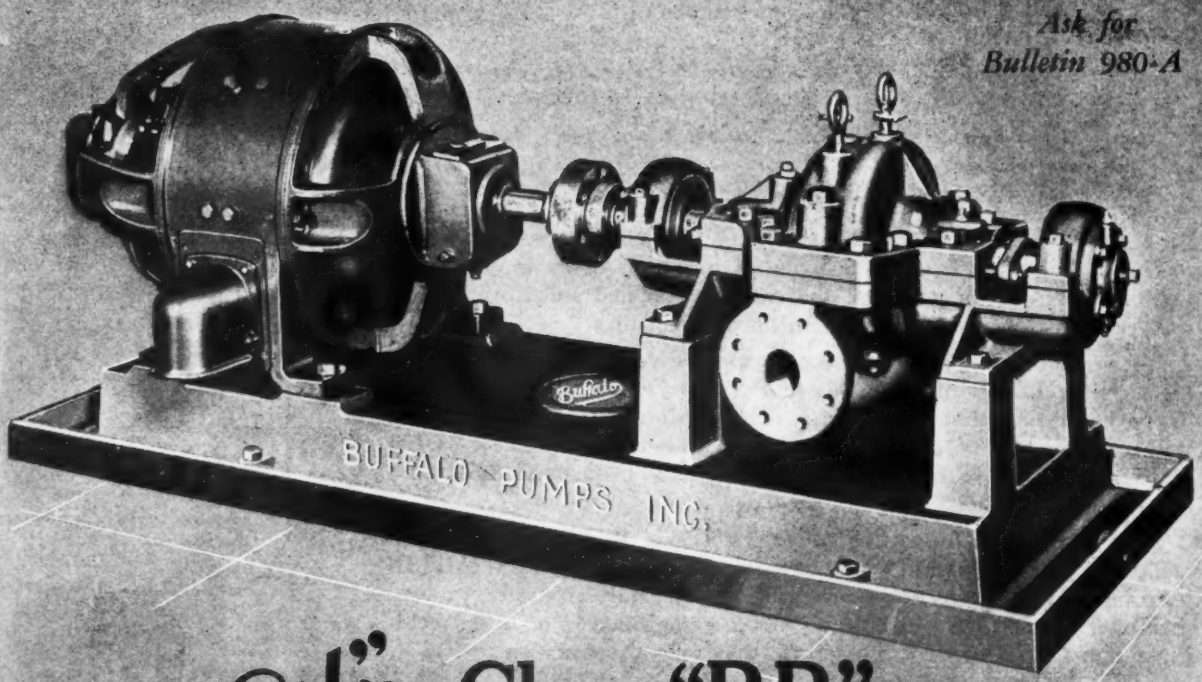
Built to give extra-fine performance handling clear water at high pressure and any temperature, the Buffalo Class "RR" Pump has semi-steel casing divided on horizontal centerline, mounted on centerline supports to equalize expansion around the shaft; enclosed mixed-flow, hydraulically-balanced bronze impellers; bronze-covered shaft; plastic metallic packing suitable for temperatures up to 600°; deep groove double-row angular-contact oversize bearings in dust-proof housing—in short, every mechanical feature desirable in a fine pump.

As for efficiency, the "RR" pump will deliver MORE water at less expense for power—users tell us that actual efficiencies are frequently better than originally specified.

Complete details on Class "RR" 2 and 4 stage pumps contained in Bulletin 980-A.

BUFFALO PUMPS, INC. • Buffalo 5, New York
CANADA PUMPS LTD., Kitchener, Ont.

Ask for Bulletin 980-A



"Buffalo" Class "RR" Single Suction MULTISTAGE PUMPS

ALL RIGHT . . . YOU NAME IT!

A side outlet tee? Hardly, because the included angle between the outlets is 120°. A cross? Well, what do you think?

Perhaps the best term would be "double branch tee". Anyway, it is formed seamless in carbon-moly—is 10" pipe size in the run with .605" wall, and 7" size in each branch with .429" walls.

This double-branch tee is just one of hundreds of examples of the endless procession of problems that we have tackled and solved across the years—many of them far more difficult than this.

No wonder, then, that we are able to give you extra values in our regular line of WeldELLS and other Taylor Forge welding fittings. There is nothing that can be desired in welding fittings which is not within the scope of our facilities, methods and experience . . . no desirable feature, in fact, that has not already been engineered into the Taylor Forge line.

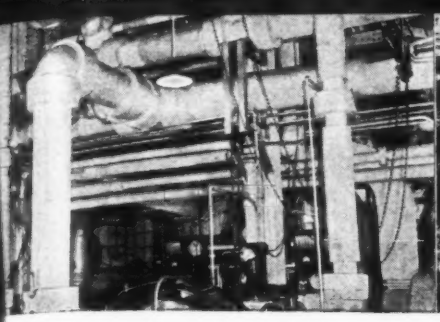
That is why you find those added touches in WeldELLS like extra metal properly distributed where stresses are greatest . . . why WeldELLS have tangents . . . why dimensions are so extremely accurate . . . why they have features, listed opposite, that are combined in no other welding fittings . . . why, in the phrase that tells the story so well . . .

WeldELLS alone combine these features:

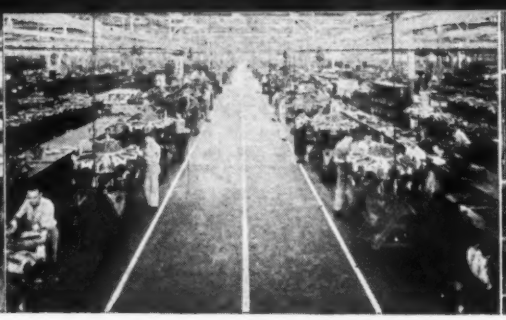
- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

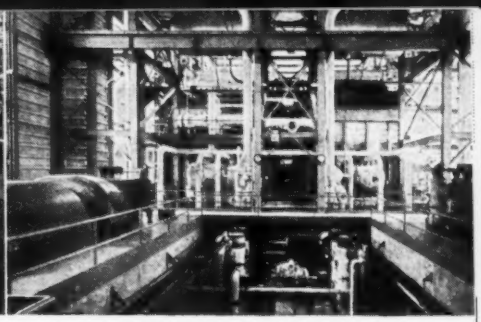
TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



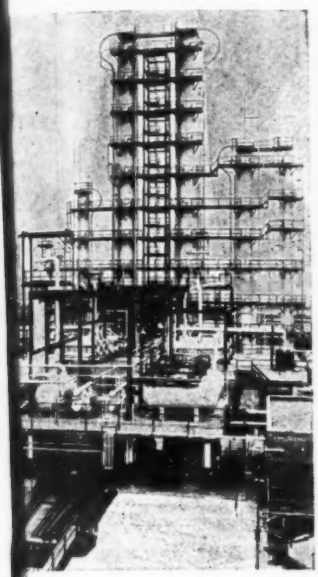
American Molasses Co., Brooklyn, N. Y., engine room. Carey 85% magnesia insulation



386 miles of Carey Insulated piping; Wright Aeronautical Corporation; Ohio



Power Station, Texas. Insulation of high pressure steam lines and equipment



Hi-octane gasoline refinery; Texas.

Carey HEAT INSULATION Service

When and Where You Want It!

Whether you need insulation for 2500°F., for sub-zero or for any intermediate temperature—

For a million dollar insulation job or a small heating system—

You will find the full line of Carey Heat Insulating Materials, and our nationwide distribution through strategically located branches and warehouses and erection crews — Efficient and Dependable.

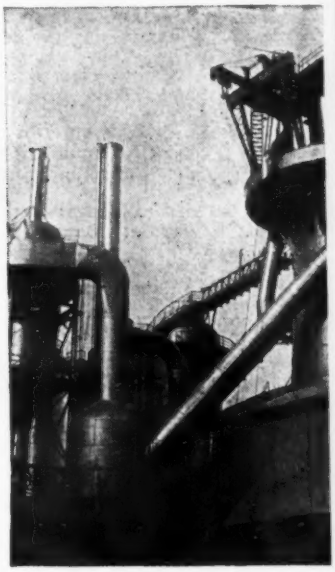
The Philip Carey Mfg. Company

Dependable Products Since 1873

LOCKLAND CINCINNATI, OHIO

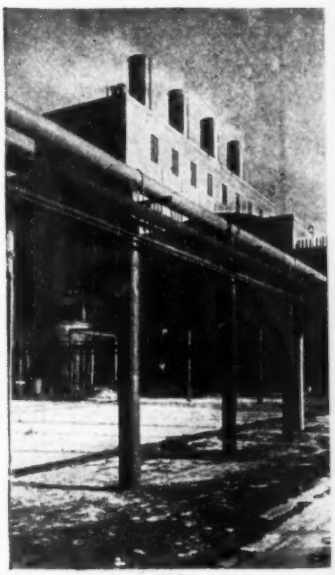
In Canada: The Philip Carey Co., Ltd.

Office and Factory: *Lennoxville, P. Q.*



Blast Furnaces; Ohio. High Temperature insulation.

Powder plant at one of world's largest powder factories; Indiana.

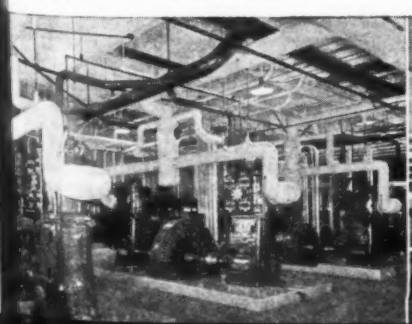


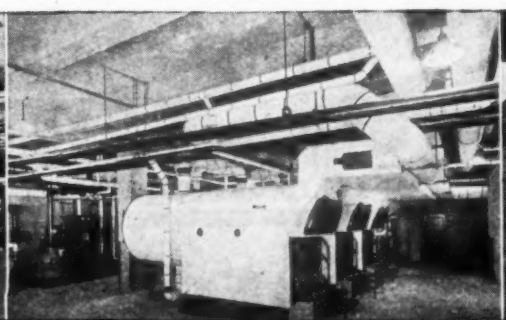
Power Station at Kobuta Synthetic Rubber Plant; Pennsylvania. This insulation job, over $1,000,000.

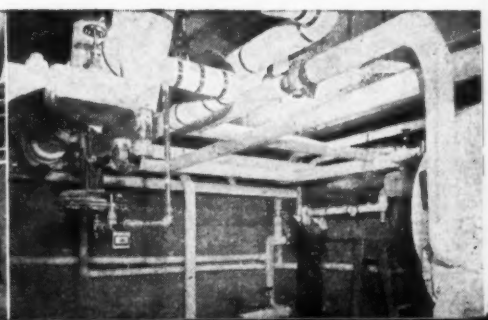
Refrigeration plant for air conditioning of textile plant; Ohio.

Heating plant in Federal building, New Orleans, La. Low temperature insulation.

Valve room, Glockner Sanitarium, Colorado Springs, Colorado.







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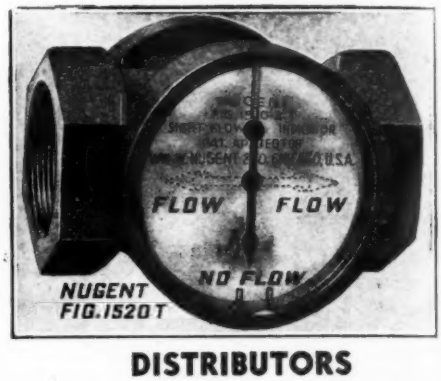

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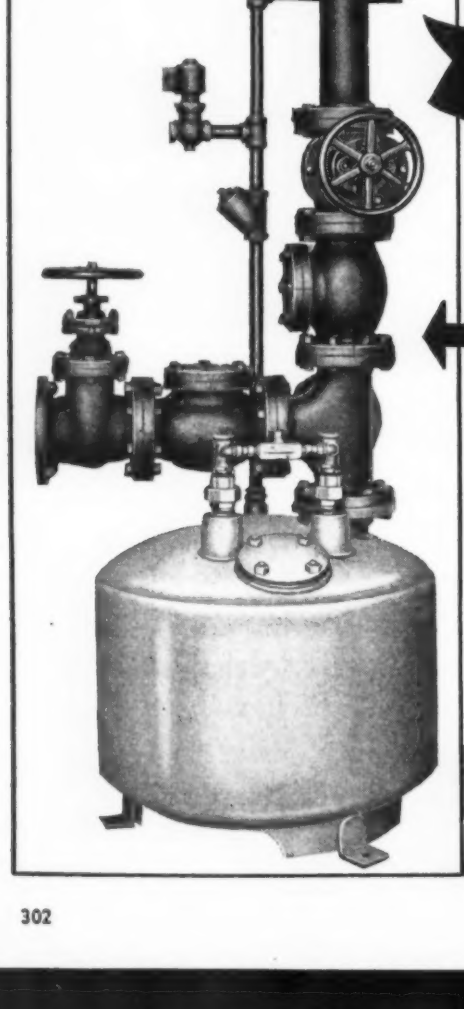

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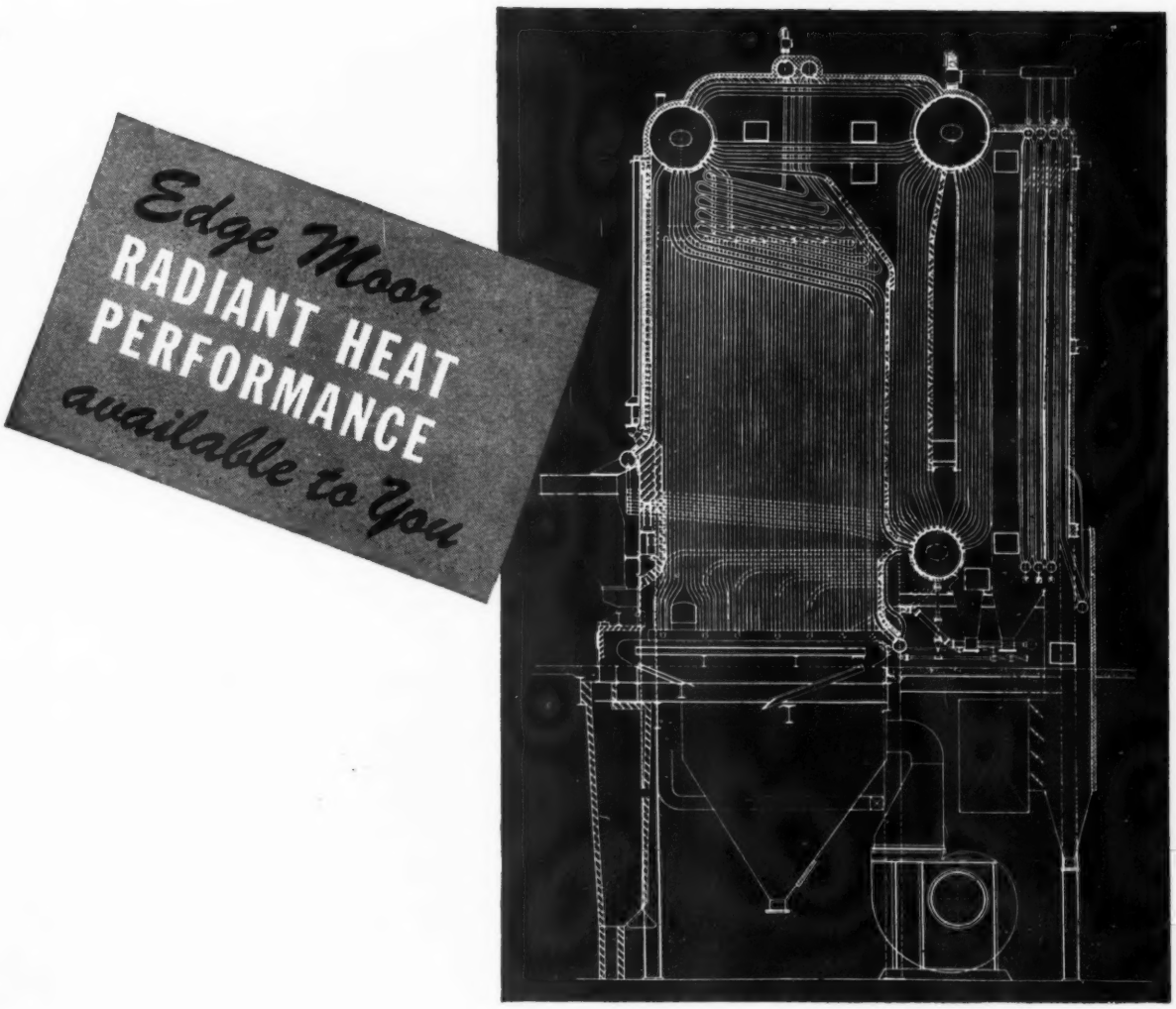

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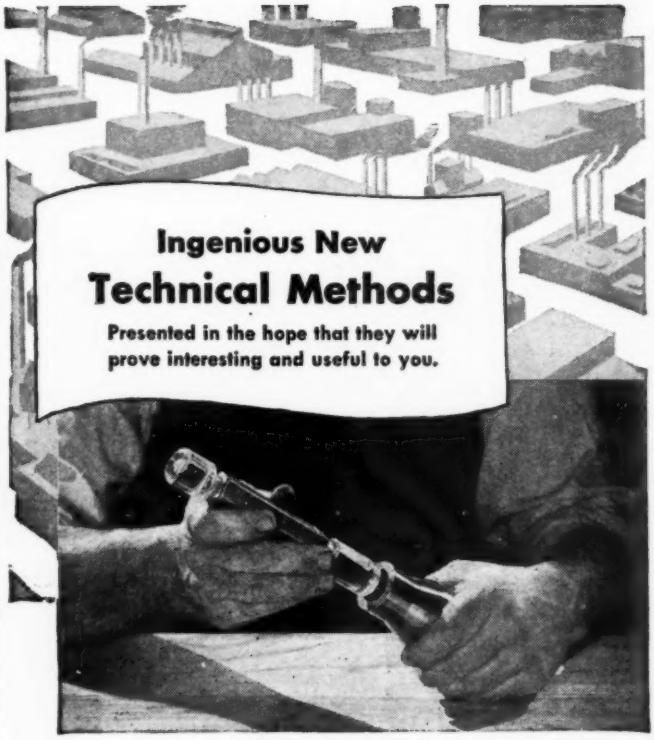

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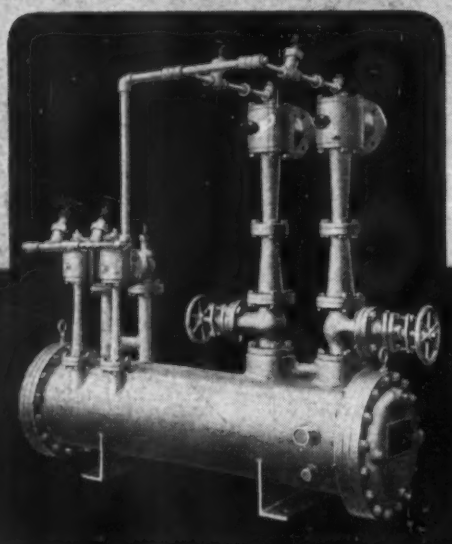

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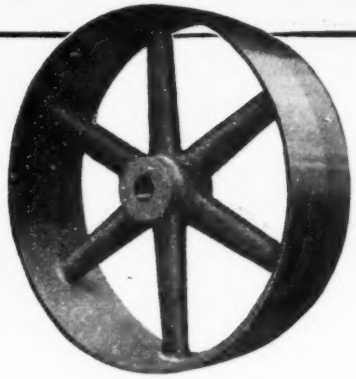

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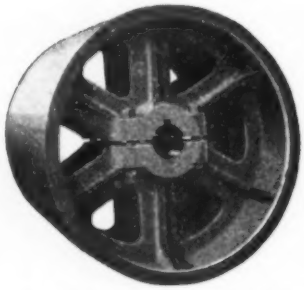

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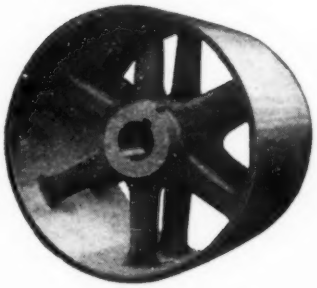

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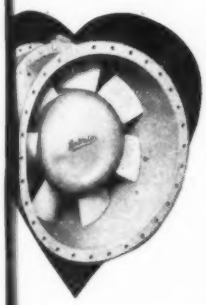

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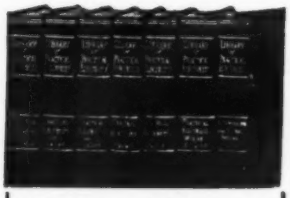

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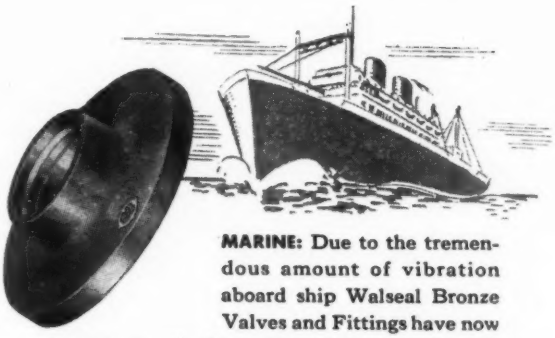

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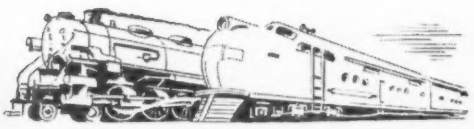

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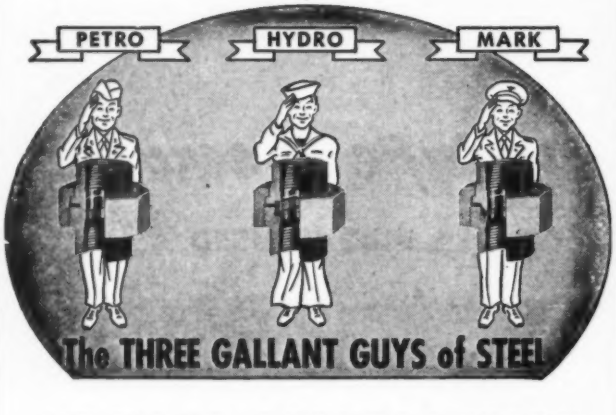

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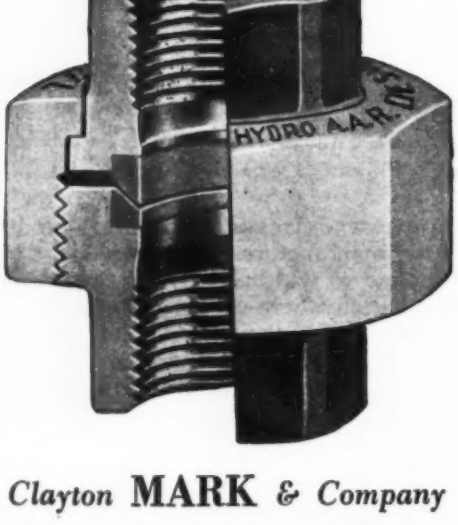

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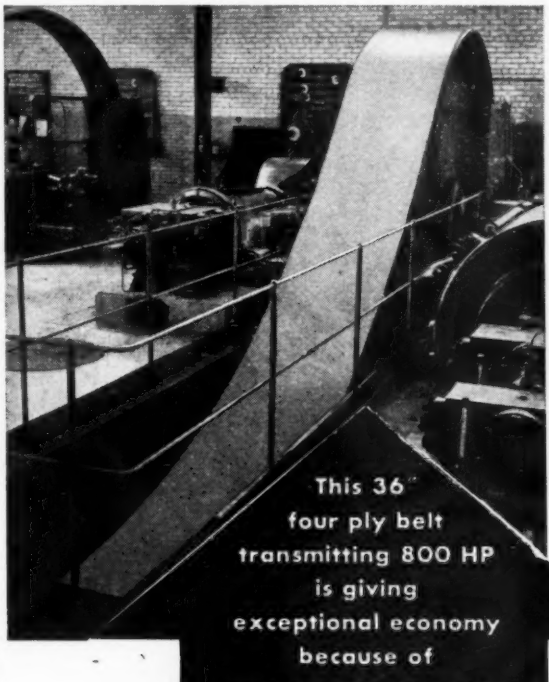

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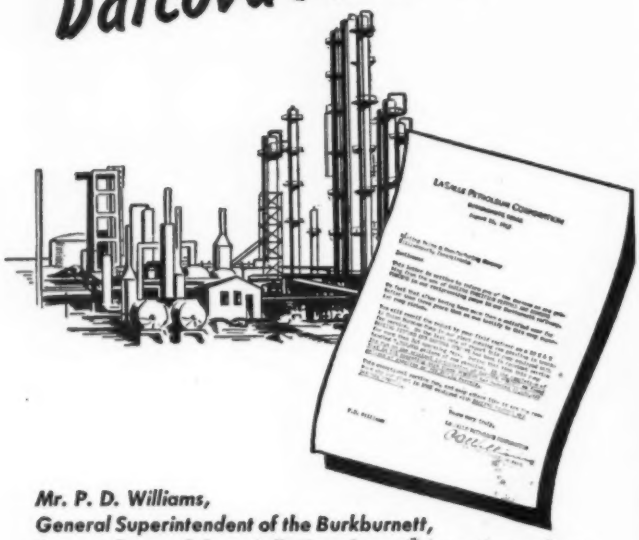

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You will recall the report by your field engineer on a 10 x 6 x 12 Union Burnham Pump in our plant pumping raw gasoline in transfer service. On the last date of report this pump equipped with DARLING PISTONS AND DARCOVA PUMCUPS had been in constant service for more than 245 operating days. During that time this pump handled 7,350,000 gallons of raw gasoline. At the completion of the run on the original installation of DARCOVA PUMCUPS we found that in 501 operating days these PUMCUPS had handled 15,030,000 gallons of gasoline or 357,857.14 Barrels.

This exceptional service run, and many others like it are the reasons why our plant is 100% equipped with DARLING PISTONS AND DARCOVA PUMCUPS.

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P. D. Williams

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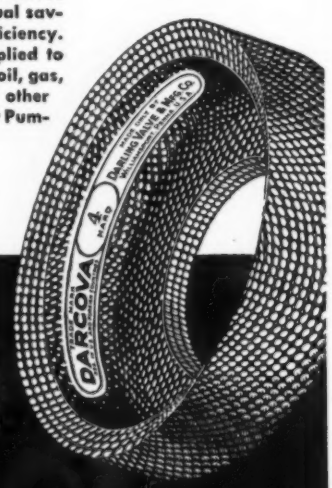

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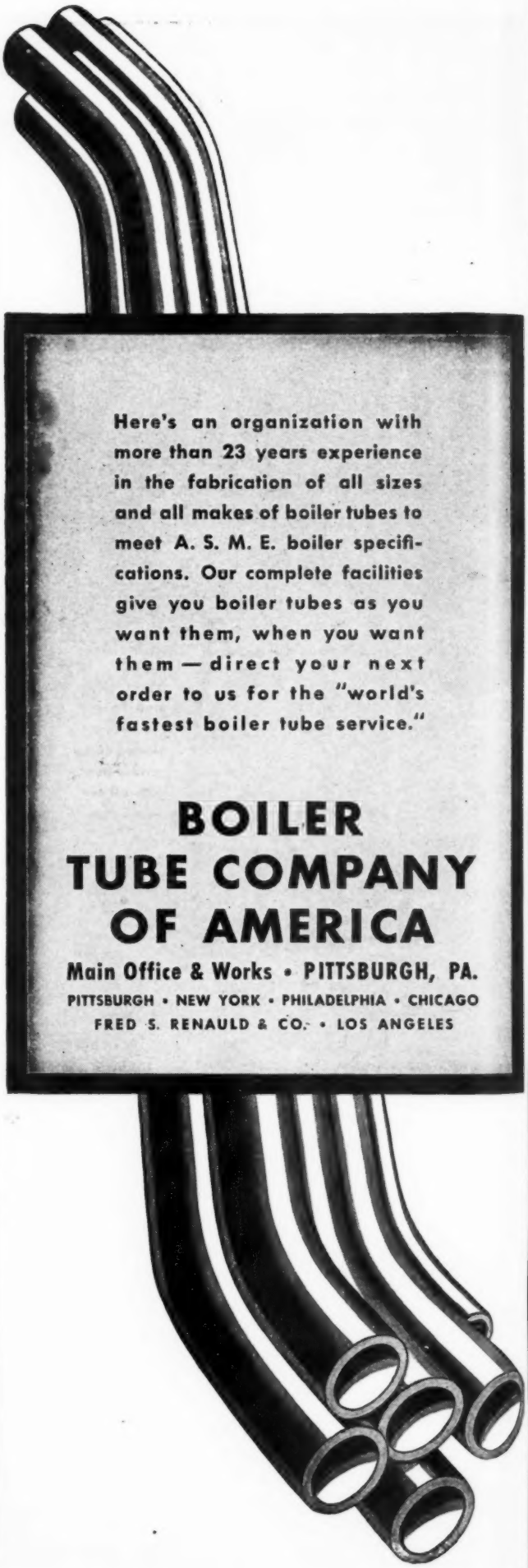

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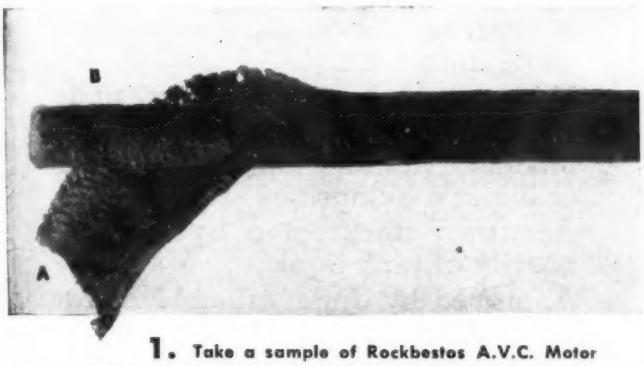
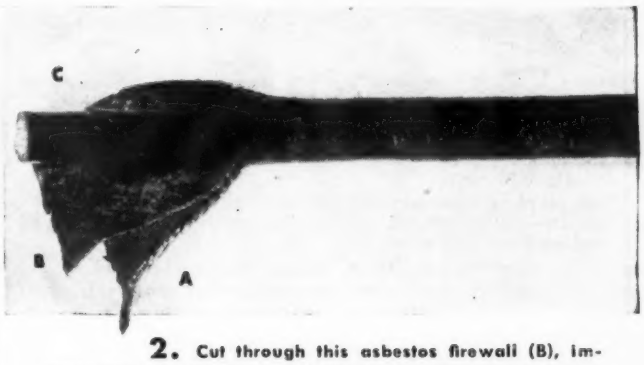
Why PERMANENTLY INSULATED ROCKBESTOS A.V.C.

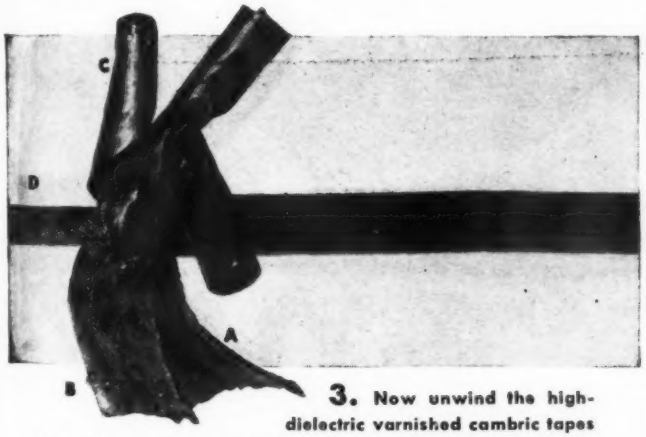
Gives Long-Lived Service Under Severe Operating Conditions



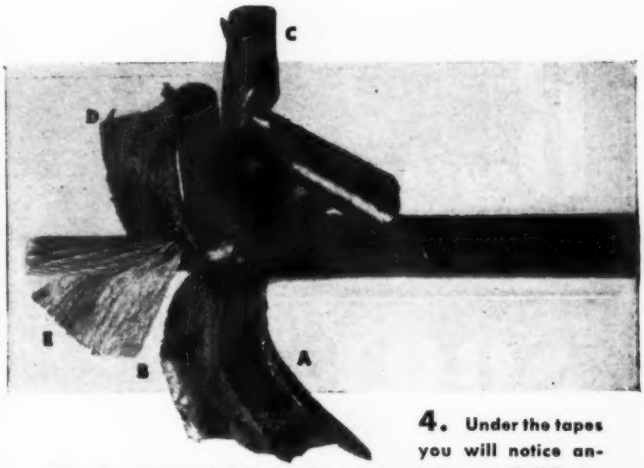
1. Take a sample of Rockbestos A.V.C. Motor Lead Cable (illustrated), or similarly insulated Power Cable, slit open the slick-finished, heavy asbestos braid (A) impregnated with heat, flame and moisture resisting compounds — a braid that won't dry out, crack or flow under heat; won't bloom, swell or rot as a result of contact with oil or grease; and won't burn or carry flame — and beneath it you will find a firewall of felted asbestos (B).



2. Cut through this asbestos firewall (B), impregnated like the braid, but felted into a permanent insulation that is resistant against heat, flame and moisture — an insulation that won't burn, bake brittle or crack with vibration — and next you'll see the lubricated varnished cambric tapes (C) which it protects from high ambient temperatures and oxidation.



3. Now unwind the high-dielectric varnished cambric tapes (C) and you will see the obvious advantages of helical construction — for uniform coverage, for dielectric stability, and to assure, together with the helically applied felted asbestos, perfect and permanent centering of the conductor in the insulation.



4. Under the tapes you will notice another impregnated felted asbestos insulating wall (D), an inner heat-barrier put there to complete the protection of the varnished cambric from the heat of conductor overloads. Slit and peel back this felted wall and beneath you'll find a thin wrapping of paper (E) over the conductor to keep it clean and make stripping easier.

Try the simple test outlined above on a sample of Rockbestos A.V.C. cable, which we will send on request, and you'll readily see why permanently insulated Rockbestos A.V.C. wires, cables and cords resist heat, flame, moisture, corrosive fumes, oil and grease — and give long-lived service under high temperatures and severe operating conditions. Write:

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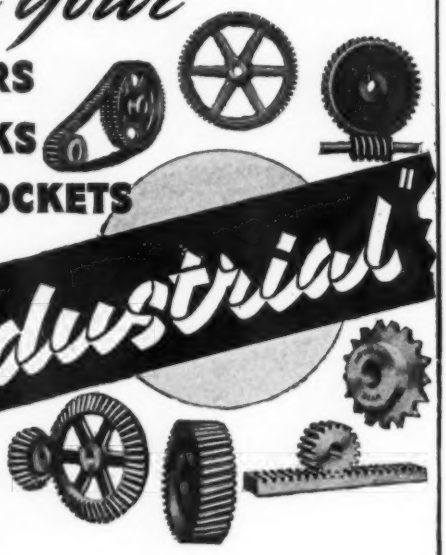

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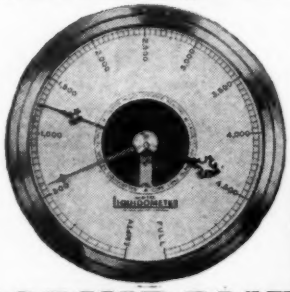

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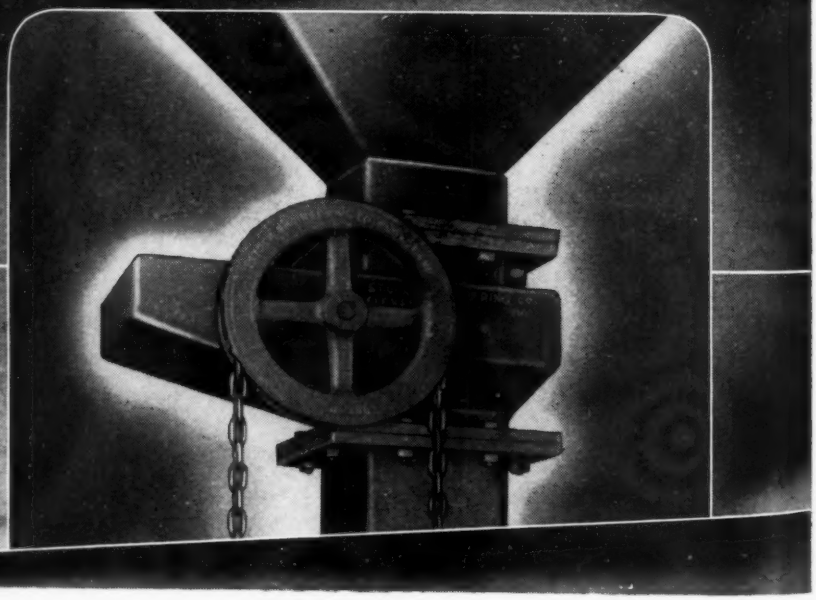

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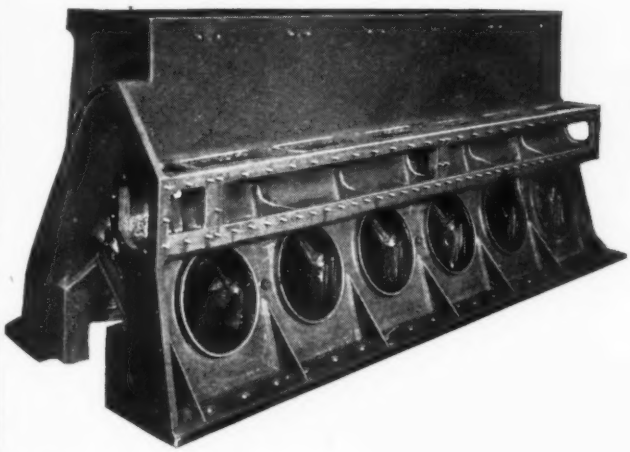

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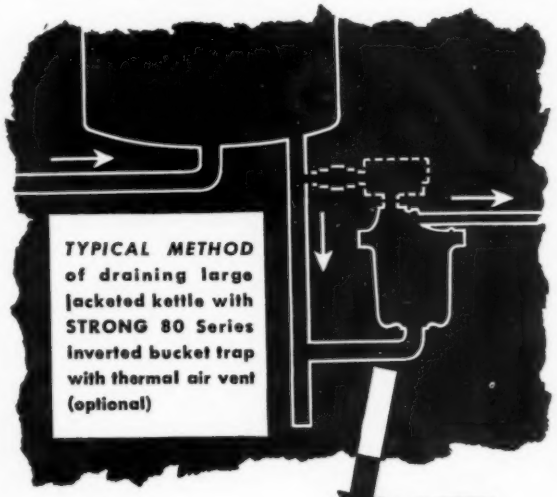

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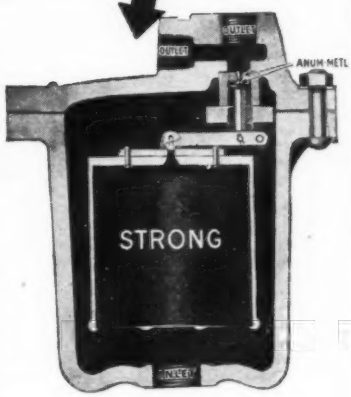

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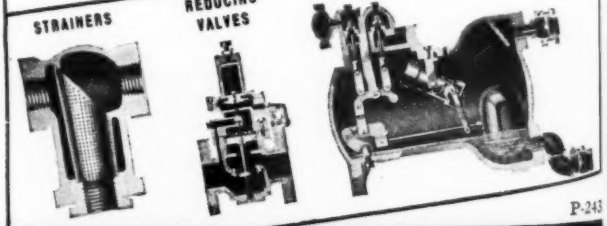

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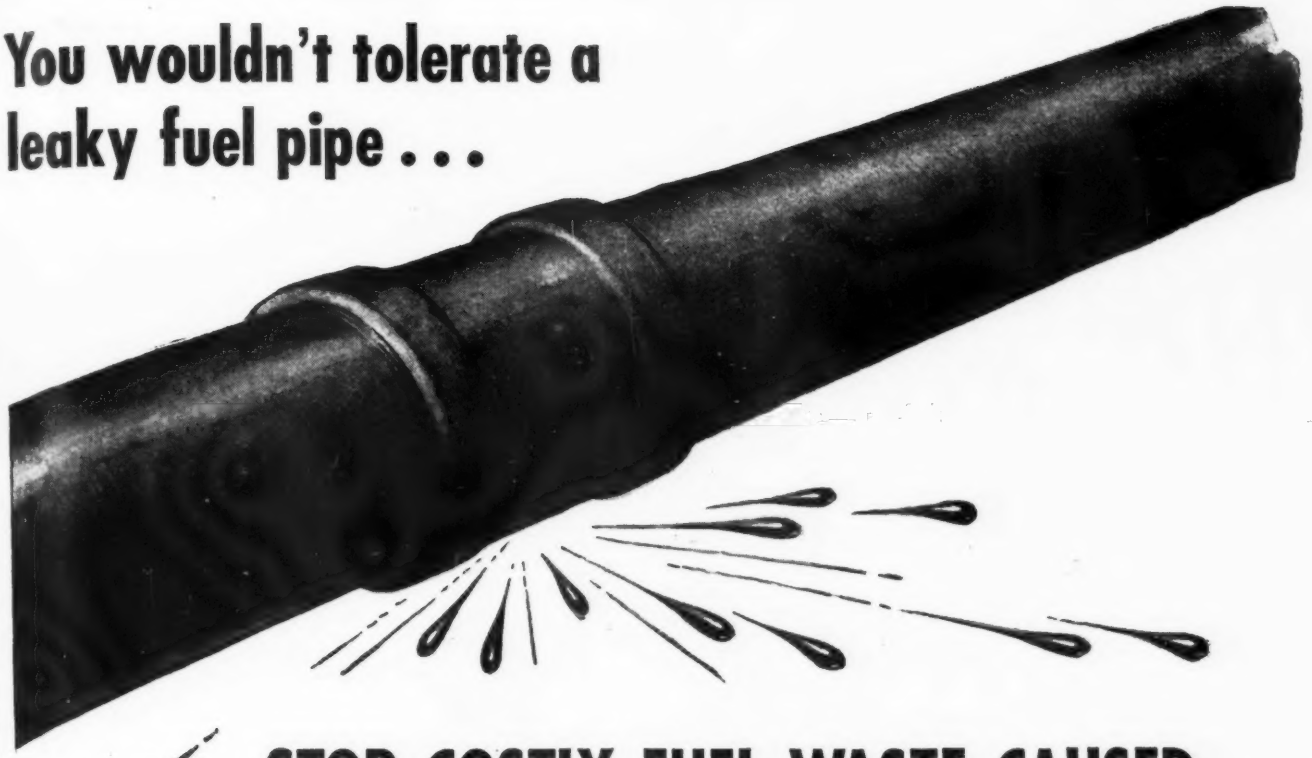

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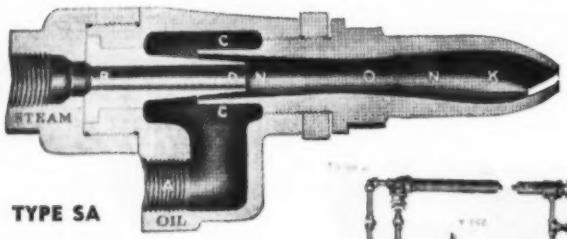

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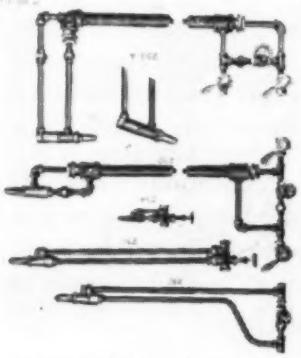

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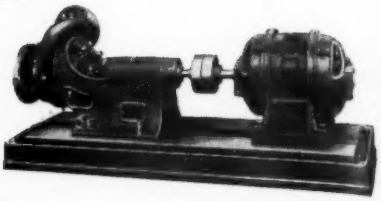

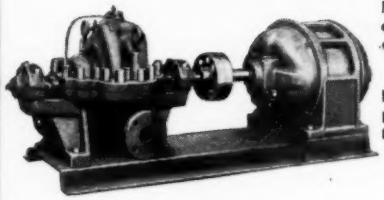

Fig. 3720 Single stage enclosed impeller direct connected centrifugal.

Fig. 3380 2 stage opposed impeller type centrifugal.

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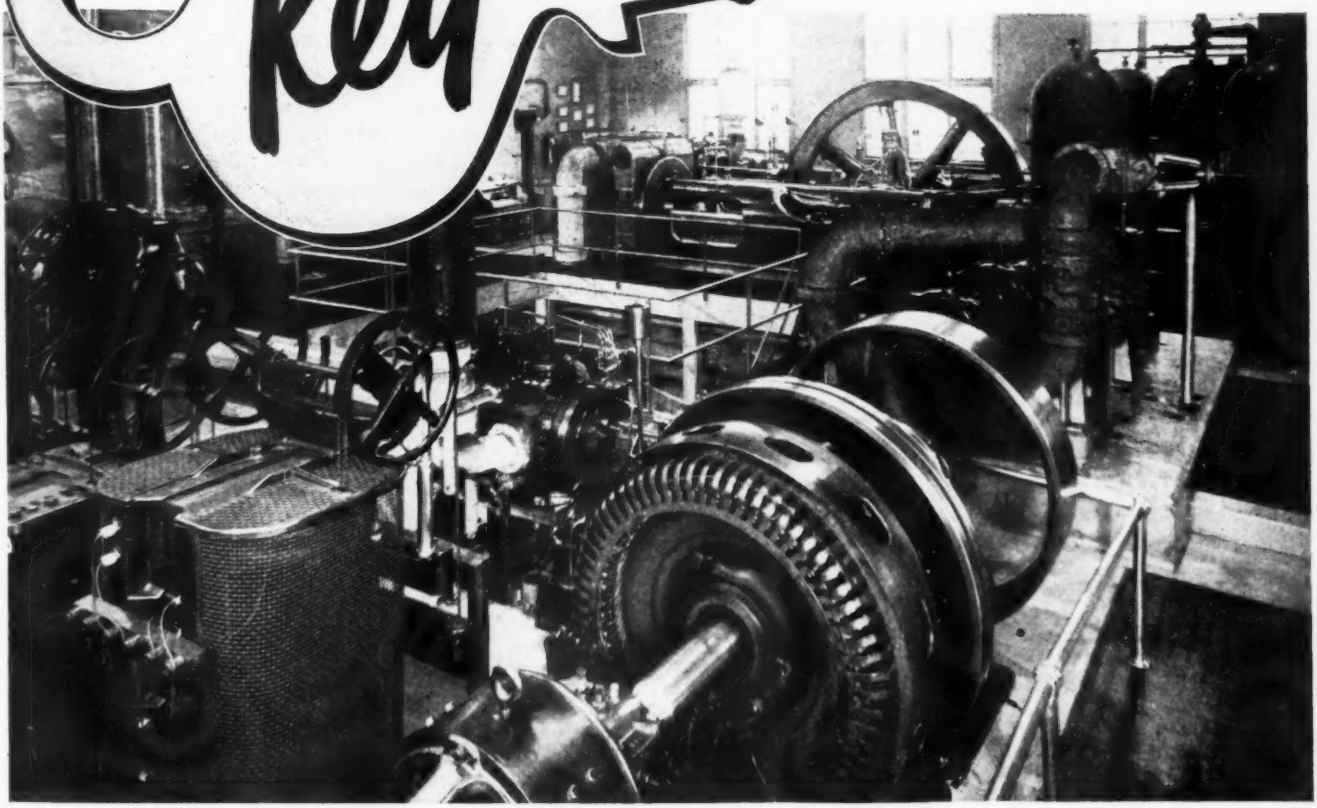

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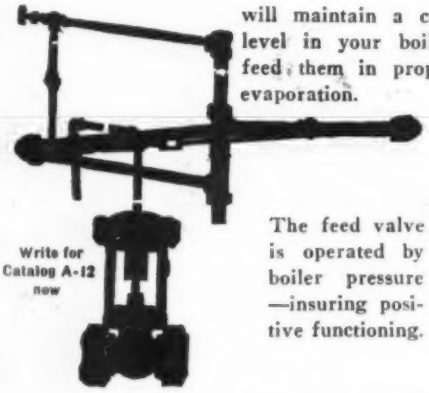

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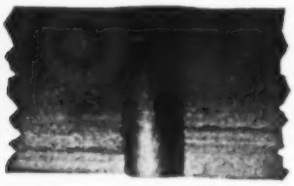

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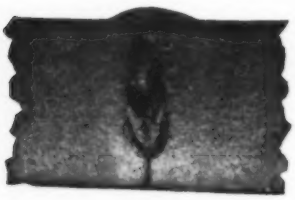

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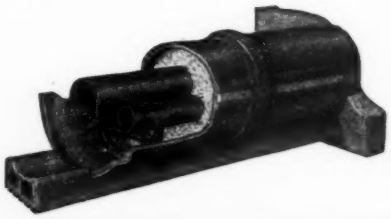

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Made of vitrified clay tile. Installed with "Fiberglas" insulation. A combination that can't be topped for permanency or efficiency.

Can be furnished for several combinations of pipe in the same conduit, thereby reducing cost.

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POST WAR NOTE

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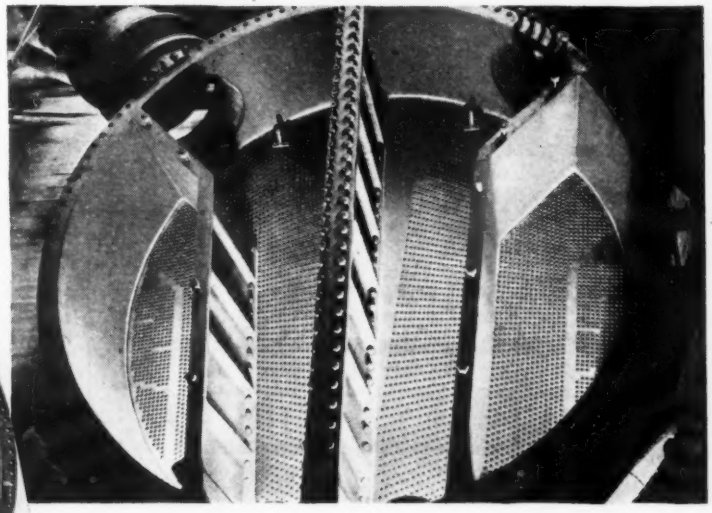
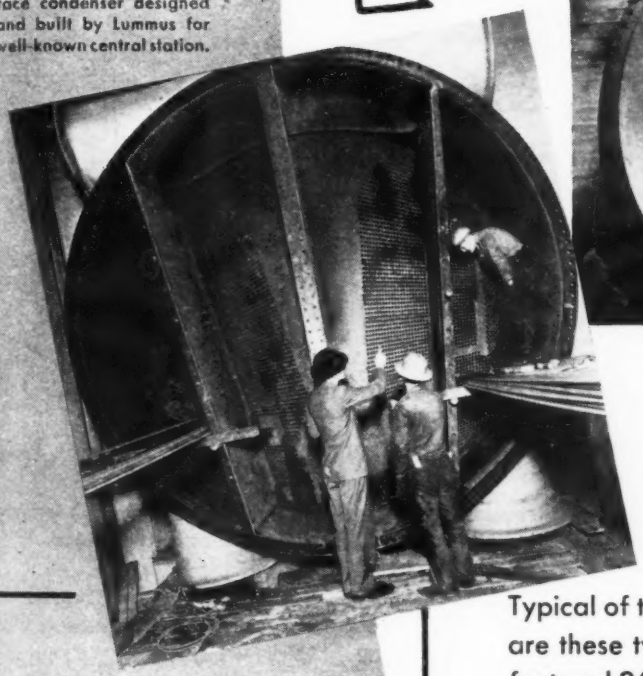


32,600 square foot surface condenser designed and built by Lummus for well-known central station.



...In these LUMMUS Surface Condensers

Typical of the efficiency and versatility of Lummus design are these two large surface condensers, 32,600 square feet and 26,500 square feet, respectively. The distinctive tube sheet layouts . . . while varied to meet individual conditions . . . provide large internal steam space with an open steam lane through the center of the condenser.

Lummus Surface Condensers are designed for full deaeration by cascading the condensate through live steam. This operation serves to prevent condensate depression even at low loads, as well as removing the soluble air. Lummus also designs and builds Steam Jet Air Ejectors for use with its surface condensers, thus eliminating divided responsibility for the proper operation of the complete plant. Further data upon request.

Lummus Power Plant Equipment

- Surface Condensers
- Steam Jet Air Ejectors
- Bleeder Heaters
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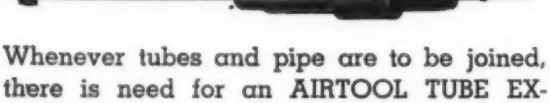
Every engineer interested in becoming acquainted with the application and operation of tube expanders in the process of tube rolling and expansion should have, for ready reference, AIRETOOL'S EXPANDER Book. It is packed with valuable technical and "know how" information. Send for your copy today. It's free—there is no obligation. Use the coupon below or write AIRETOOL a card or letter.



Whenever tubes and pipe are to be joined, there is need for an AIRTOOL TUBE EXPANDER. They are precision made, long lasting and versatile. Made to meet every tube expansion need—to fit every type and size of tube. Special types for unusual conditions. Right angle or universal drives where the opening is hard to reach.

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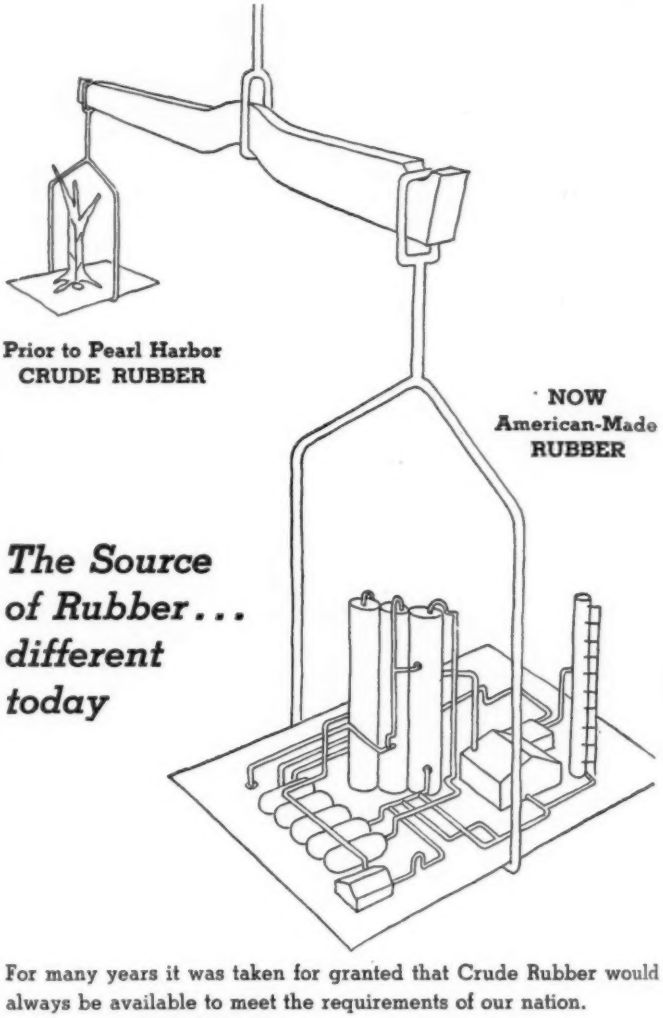

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For many years it was taken for granted that Crude Rubber would always be available to meet the requirements of our nation.

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Instantly a vast change was made in the source of supply. Only American ingenuity prevented a complete collapse in the supply of this most vital raw material.

At the start, the production was only a few tons of American-made rubber. In the short space of two years, production is taking care of the War demands. Besides, there is now some American-made rubber available for civilian requirements.

Today, American-made rubber is doing a wonderful job. The United States is almost entirely dependent on it. Don't waste or misuse any product made of rubber. American-made rubber uses American-made raw materials and American Labor and keeps the money in circulation in America.

Quaker for many years has been most active in experimenting and working with American-made (Synthetic) rubber. In many instances, it has already proven better for certain kinds of work than Crude.

When you need Industrial Rubber Products, consult Quaker. Even during these trying days, Quaker has been able to supply Industry with a considerable quantity of Rubber Products, in addition to the large volume of Products which we are constantly supplying the Government.

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If there is a way to get it done—
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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Increasing Condenser Tube Life

Care and Maintenance Will Conserve Essential Copper-Base Alloys

At this writing both marine and power plants are permitted to purchase all of the standard condenser tube alloys with the exception of the Cupro Nickels which are still restricted for Government use. This is really welcome news for those power plants whose retubing is long overdue. The engineer can now select something besides Muntz and Admiralty for severe service where the more corrosion resisting alloys such as Cuzinal and Duronze IV will last longer.

However, copper-base alloys are still on the critical and war essential list and must be conserved. How to keep existing condenser tubes in service longer remains the number one problem for the operating engineer. Fortunately, much can be done to reduce the ravages of corrosion if some of the causes are recognized and steps are taken to correct them.

Cleanliness of Tubes Important

Without going into lengthy and complicated scientific explanations as to the various types of corrosion, and their causes, we know, for example, that an accumulation of sand, ashes, shells, weeds, leaves, slime, rust and other debris in condenser tubes tends to encourage pitting, dezincification, and other types of corrosion. Extreme cases have been reported where large pieces of stone or coke lodged in a condenser tube were responsible for severe localized corrosion. The following suggestions are intended to help keep tubes cleaner and thereby prolong their life.

1. Dredge channel and keep intake tunnel clean.
2. Use screens fine enough to prevent debris from entering the condenser tubes.
3. Clean out water box and keep the paint intact.
4. Clean out tubes regularly with high pressure air or water applied at the exit end. The pushing of rubber plugs through the tubes is also effective. Do not use wire brushes.
5. Flush tubes with clean water when ship is in port.
6. If troubled with marine growth, investigate possibilities of using chlorination.

Air in Water Accelerates Pitting

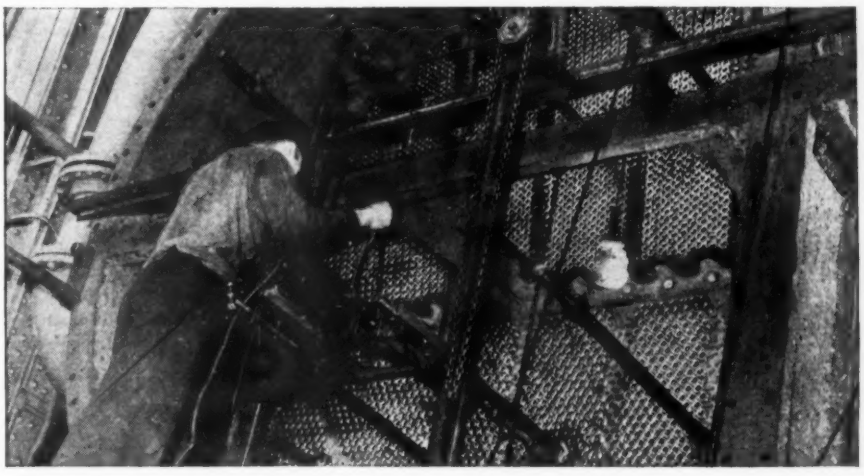
It is common knowledge that air or gas bubbles greatly accelerate condenser tube corrosion. Care must be taken first to prevent excessive air from entering the water, and second, dissolved air must be stopped from separating in the form of bubbles and coming into contact with the tubes. The first is accomplished as follows:

1. Check all valves, bonnets and glands to prevent air from entering water stream.
2. Use a device on water box, such as an air venting system (air and erosion eliminator) for expelling entrained air.

Since reduction of water pressure also causes the release of air, care should be taken, when tubes are installed, not to use protruding ferrules or tubes. Streamlining the water flow into the condenser can be accomplished by using flush type ferrules or by belling and expanding the inlet ends of the tubes.

Bridgeport's New Condenser Tube Manual

Much practical information about the newer types of condenser tube alloys, chemical and physical specification, methods of installing, corrosion research data, suggestions for increasing tube life and many valuable suggestions are published in Bridgeport's new Condenser Tube Manual. If you do not have a copy, why not drop us a line?



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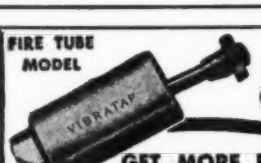
FIRE TUBE MODEL



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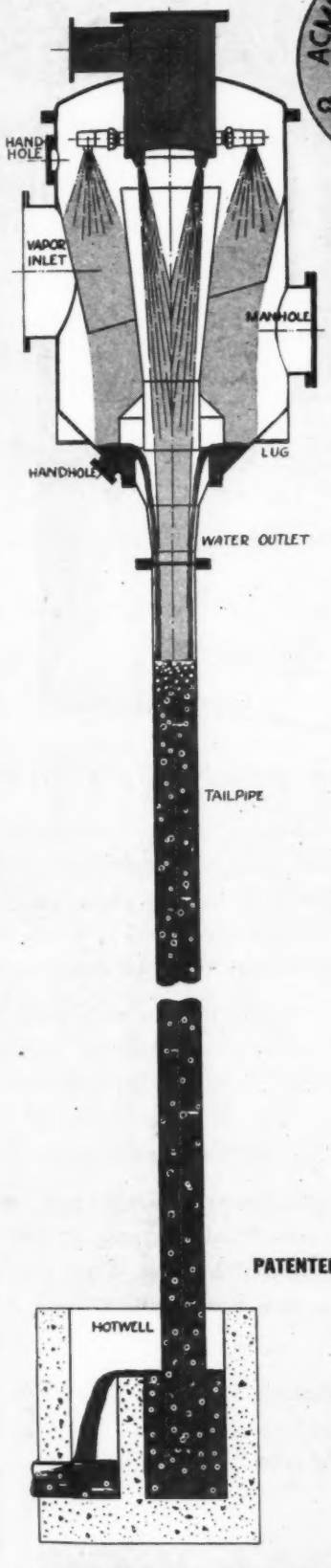

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BY USING THE *PRACTICAL*

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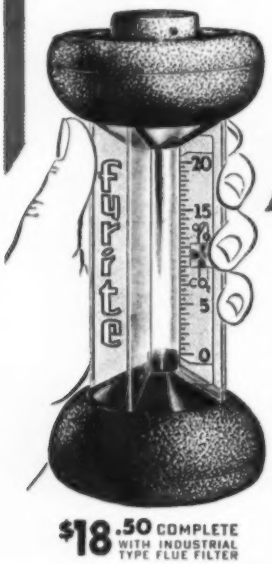

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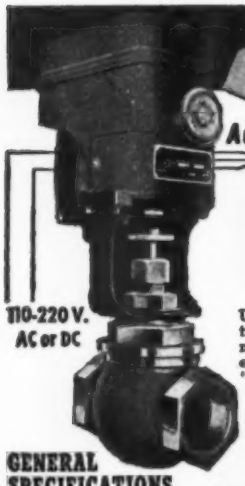

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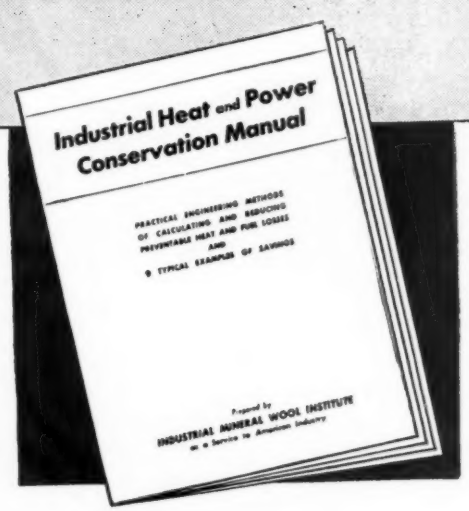
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Remember the whole country is being enlisted in this drive. You'll be a soldier in a mighty army of paper conservers.

And remember, right now, there's no home-front conservation job any more urgent or important than the conservation of paper and paper board.

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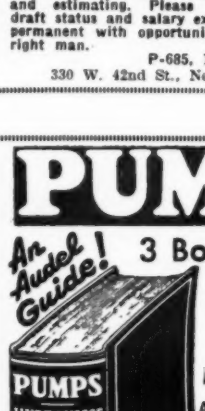
PUMPS



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HELP WANTED—MALE
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Thoroughly experienced engineering design mechanical sections of steam power plants for industrial and utility applications involving moderate to high pressure-temperature steam and efficient burning various fuels. Should have administrative and executive ability and capable further development. Age 35-45. First reply must give full particulars as to age, education, specific experience in detail, availability, draft status, salary, etc.; attach photograph which will not be returned. Location New York. If now employed at highest skill, do not reply.

P-686 Power
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POWER SUPERVISOR, thoroughly experienced in modern high pressure Power Plants and organizing and handling of personnel. Partial technical education, eighteen years experience. Prefer Southern connection. PW-659, Power, 330 W. 42nd St., New York 18, N. Y.

ELECTRICAL ENGINEER with 14 years experience in the fields of construction and operation of diesel and hydro electric power plants, transmission systems, mining, milling and industrial installations. Married with small family, 40 years of age, class 3A(H), excellent health and no physical handicaps. At present am managing-supt. of a municipal power plant and distribution system in a town of about 1500. Reason for desired change is to be located where more sunshine and better schools are to be enjoyed, also, that present position holds no further future for advancement. Definitely not a boomer or drinker, excellent references. Availability on 30 days notice. Write PW-673, Power, 68 Post St., San Francisco 4, Cal.

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ELECTRICAL POWER EQUIPMENT

TURBO GENERATORS

3 Phase, 60 Cycle

1875 KVA ALLIS CHALMERS condensing, 175 lbs., 2300 volts, with jet condenser.

1250 KVA WESTINGHOUSE non-condensing, 150-300 lbs., 0-75 lbs. back pressure, 480 volts.

940 KVA WESTINGHOUSE condensing, 200-400 lbs., 6600 volts with surface condenser.

SURFACE CONDENSER

1540 sq. ft. WORTHINGTON surface condenser with steam jet air pumps.

ENGINE GENERATORS

3 Phase, 60 Cycle

438 KVA GENERAL ELECTRIC-SKINNER uniflow, 150 lbs. 5 lbs. back pressure, 240/480/2300 volts, 150 RPM.

340 KVA WESTINGHOUSE SKINNER uniflow, 150 lbs., 5 lbs. back pressure, 240/480/2300 volts, 200 RPM.

250 KVA GENERAL ELECTRIC-SKINNER uniflow, 150-175 lbs. 5 lbs. back pressure, 240 volts, 225 RPM.

210 KVA GENERAL ELECTRIC engine type generator, 2300 volts, 225 RPM.

150 KVA GENERAL ELECTRIC-AMES counterflow, 100-150 lbs., 5 lbs. back pressure, 240 volts, 257 RPM.

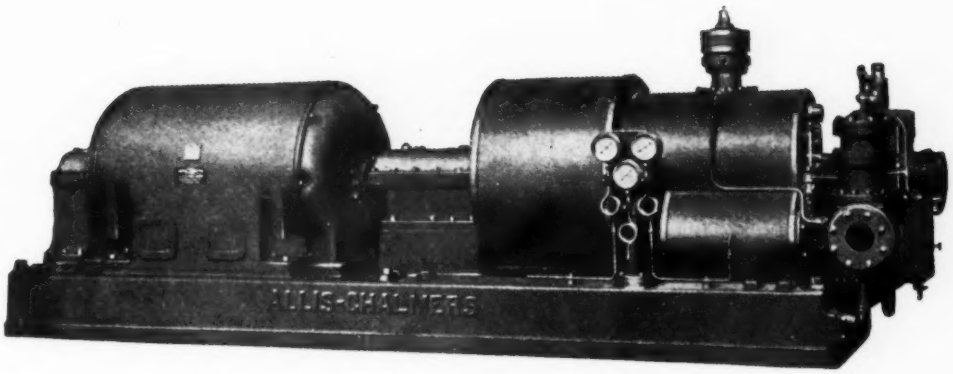
MOTOR GENERATORS

3 Phase, 60 Cycle

1500 KW WESTINGHOUSE synchronous 275 volts D.C., 2200 volts A.C., 514 RPM.

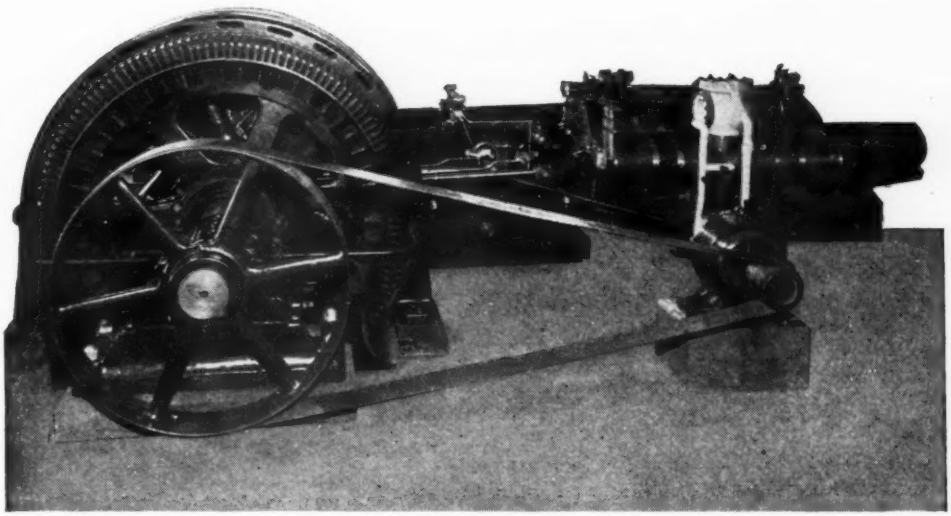
1000 KW GENERAL ELECTRIC 3-UNIT synchronous 125/250 volts D.C., 4000/2300 volts A.C., 720 RPM.

150 KW WESTINGHOUSE synchronous, 250 volts D.C., 2200/4400 volts A.C., 900 RPM.



1250 KVA ALLIS CHALMERS CONDENSING TURBO UNIT

1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.



Actual Photograph

675 KVA SKINNER UNIFLOW UNIT

675 KVA Electric Machinery alternating current generator 3 phase 60 cycle 2300/600/480 volts direct connected to Skinner Universal uniflow engine, 150-175# steam pressure, 0-10# back pressure, 150 RPM.

ROTARY CONVERTERS

3 Phase, 60 Cycle

3500 KW (2) WESTINGHOUSE 225-285 volts D.C., 225 RPM, with 13200 volt transformers.

750 KW GENERAL ELECTRIC 600 volts D.C., 1200 RPM, with 2300/4000 volt transformers.

DIESEL GENERATORS

3 Phase, 60 Cycle

431 KVA WESTINGHOUSE-WORTHINGTON 480 volts, 360 RPM.

312 KVA WESTINGHOUSE-WORTHINGTON 480 volts, 327 RPM.

250 KVA WESTINGHOUSE-WORTHINGTON 480 volts, 327 RPM.

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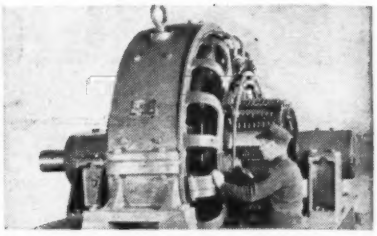
Step Up Your Power
QUICK WITH
Stock Equipment



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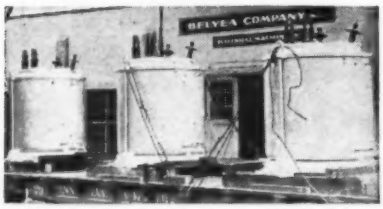

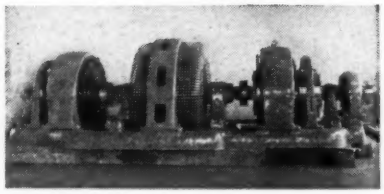

MOTOR GENERATOR SETS
3 Phase 60 Cycle

1—1500 KW G.E., 275 V, D.C. to 2100 H.P., 2300 V.

1—1500 KW WHSE., 250 V. D.C. to 2100 HP., 440/2200 V.

1—1000 KW WHSE., 600 V. D.C. to 1400 H.P., 4000 V.

1—500 KW G.E., 600 V. D.C. to 700 H.P., 13200/6600 V.

1—400 KW G.E., 250/275 V., D.C. to 600 H.P. 2300 V.

1—350 KW G.E., 220 V.. A.C. Gen. d.c. to 500 H.P.. 230 V. D.C. Motor.

1—115 KW G.E., 250 V. D.C. to 175 H.P., 440 V. Ind Motor.

1—100 KW WHSE., 250 V. D.C., to 160 KVA, 2300 V.

1—75 KW G.E., 125 V. D.C. to 120 H.P., sq. cg. 2300/4000 V.

1—50 KW G.E., CD, 125 V. D.C. to 75 H.P., sq. cg., 2300/4000 V.

1—40 KW WHSE., 230 V. D.C. to 45 KVA 2300 V.

1—35 KW A. B. See 230 volt D.C. to 50 H.P. 220 volt sq. cg. motor with exciter.

TURBO GENERATOR SETS

1—500 KW Whse. 625 Kva. 440 V. 3 h. 60 cy. 3600 RPM with Parsons 145/175 lb. cond. turbine complete with jet cond. and access.

1—75 KW Ridgeway 250 V. D.C. with Terry turbine 180 lb. pressure with 12 lb. bk. pres., 2000 RPM.

A. C. GENERATORS AND SYNO. MOTORS
3 Phase—60 Cycle

HP or KVA	Make	Type	Volts	Speed
2—2100	G.E.	ATI	2300	514
1—1000	Whse.		2300	900
1—750	G.E.	ATI	220/440	900
1— 600	G.E.	ATI	220/440	900
1— 625	Whse.		450	900
1— 500	G.E.	TS	440	360
1— 225	G.E.	ATB	220	600
1— 168	Al. Ch.		2300	900
1— 150	Whse.		4000	1800
1— 125	G.E.	ATB	220	900
1— 100	G.E.	ATB	220	720
2— 100	Whse.		2300	1800

A. C. MOTORS
3 Phase—60 Cycle
SLIP RING

HP	Make	Type	Volts	Speed
1—1200	Cr. Wh.	801Q	2300	237
1— 800	Al. Ch.	ANY	440	885
1— 800	Whse.	CW	440	357
2— 600	G.E.	IP	440/2200	720
1— 450	Whse.	HW	2200	875
1— 400	Al. Ch.	ANY	2300	505
1— 400	G.E.	IP	440/2200	600
1— 350	G.E.	MT-442	2300/4000	257
1— 300	G.E.	IM	440	720
1— 300	Whse.	CW	440	585
1— 250	G.E.	MT	4000/2300	257
1— 200	G.E.	IF-M	2200	1750
1— 200	Whse.	CW	2200	514
1— 200	G.E.	I-M	440	600
1— 150	G.E.	IM	2200	695
1— 150	G.E.	MT 564	440	600
1— 150	G.E.	IM-17B	2200	290
1— 100	G.E.	IM	220	1750
1— 100	G.E.	MTC-5546	220/440	860
1— 100	Whse.	CW-752C	550	1160
2— 100	G.E.	IM	2200	575
1— 100	G.E.	MTC-5552	550	685

SQUIRREL CAGE

HP	Make	Type	Volts	Speed
1—500	G.E.	1-17B	2200	690
1—400	Whse.	CS-1104A	2200	585
1—350	G.E.	IK	440/2200	450
2—300	G.E.	IK	440	350
1—300	Whse.	CS	550	580
1—300	G.E.	IK	440/2300	600
1—200	G.E.	IK	2300	490
4—175	G.E.	IK	440	900
1—125	Whse.	CS	220/550	1150
1—125	G.E.	IK	220	720
1—100	Whse.	CS	550	1750

GEAR REDUCTION UNITS

1—21 H. P. Whse. 1800/360 RPM.
1— 943 H.P. G.E. 5306/1200 RPM.
1— 450 H.P. G.E. 3600/1200 RPM.

THE BELYEA REPUTATION PROTECTS YOU!

ROTARY CONVERTERS
3 Phase, 60 Cycle

Qu.	KW	Make	Speed	DC	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	G.E.	900	600	13200
1	1000	Whse.	600	250	22000
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
2	300	G.E.	1200	600	2300

3 Phase, 25 Cycle Booster Type

2	1500	G.E.	500	225/275	13200/6600
1	500	G.E.	750	225/275	13200/6600

All units can be furnished with AC and DC controls

TRANSFORMERS
60 Cycle

KVA	Make	Ph.	Type	Voltages
6—1667	Pitts	1	OISC	13200x2300
4— 525	G.E.	1	HJ-DD	2300x445
3— 333	Maloney	1	OISC	22000/11000x2300/575
2— 333	Whse.	1	OISC	2300x460
2— 333	Pitts	1	OISC	2400x220
3— 300	G.E.	1	H	13200x2300/575
3— 200	G.E.	1	H-KS	2300/4000x115/230
3— 200	G.E.	1	HILD	26400x115/460
2— 200	G.E.	1	H-KDD	13800x220/440
3— 150	Whse.	1	SKM	2400x120/240
6— 100	Whse.	1	SK	6900x460/230
3— 100	Whse.	1	OISC	13200x250

D. C. MOTORS

HP	Make	Type	Volts	Speed
2—1250	G.E.	MPC	500	130
1— 800	G.E.	MPC	550	600
2— 625	G.E.	MPC	250	130
1— 600	G.E.	MPC	550	600/800
1— 500	G.E.	MPC	230	900
2— 300	G.E.	DMC	230	400/600
2— 300	Whse.		500	250/400
1— 300	G.E.	MPC	230	275/550
1— 300	G.E.	MPC	230	250/440
1— 250	G.E.	C	230	375
1— 250	Al. Ch.	Irt	230	525
2— 200	Whse.		230	400/500
1— 175	Whse.	SK	250	150/525
1— 150	G.E.	RC-19	230	800/1000
1— 150	Whse.	SK	230	300/900
1— 150	G.E.	MPC	230	250/450
2— 130	Cr. Wh.	CMC-65H	550	1200
2— 125	G.E.	CO-1832	230	625
2— 120	Whse.	SK	230	720
2— 100	G.E.	LC	230	1200
1— 100	G.E.	MPC	230	225/450
1— 100	Whse.	SK	230	600
1— 100	G.E.	RC-19	230	575/720
1— 75	G.E.	C	230	500/1000
2— 70	Whse.	SK-183	230	560/780
1— 60	Al. Ch.	E-146	115	115
1— 60	Al. Ch.	E-131	115	175
1— 60	Diehl	K-11	230	500/1000
2— 60	Cr. Wh.	CMC-65H	230	500/1000
1— 50	Cr. Wh.	CMC-81H	230	300/900
1— 50	Cr. Wh.	CMC-80H	230	380/750
9— 50	G. E.	RF-16	230	400/1000
1— 50	G. E.	RC-19	230	400/1200

RE-NU-BILT BELYEA MOTORS

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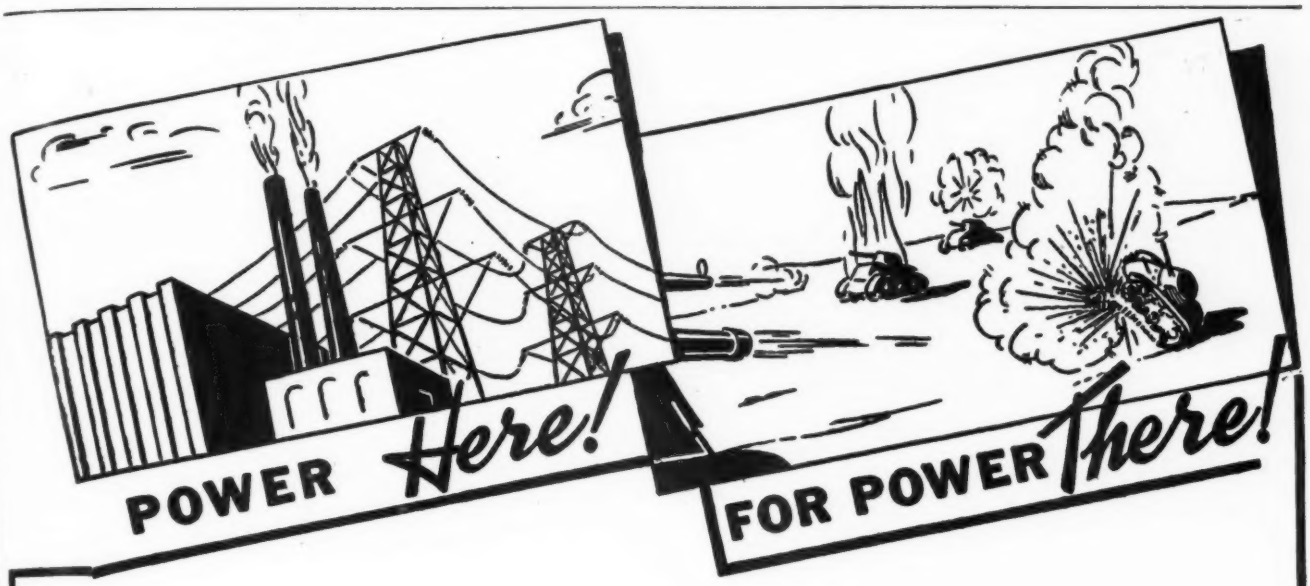
COMPANY INC.

Main Office & Shop: **43 HOWELL ST., JERSEY CITY, N. J.**



MOTORS GENERATOR SETS

1—2000 ampere, 6 volt, Hanson-Van Winkle
1—750 KW, 250 volt, Allis Chalmers synchronous
1—75 KW, 125 volt, General Electric, squirrel cage.
1—20 KW, 600 volt, General Electric, squirrel cage induction motor.
2—15 KW, 250 volt, General Electric, squirrel cage
1—6½ KW, 125 volt, General Electric, squirrel cage

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chal.

MOTORS—3 PHASE 60 CYCLE

1—500 HP, 900 RPM, Lincoln, 440 volt, slip ring.
1—400 HP, 514 RPM, 440 volt, Westg., slip ring.
1—350 HP, 300 RPM, 440 volt General Electric slip ring.
1—325 HP, 600 RPM, 2300 volt, G.E., syn.
1—300 HP, 720 RPM, 2200 volt, G.E., slip ring.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—250 HP, 600 RPM, 4000 volt, G.E., syn.
1—200 HP, 600 RPM, 2200 volt, G.E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—150 HP, 1800 RPM, 440 volts, General Electric, squirrel cage.
1—150 HP, 1750 RPM, Westinghouse, slip rg.
1—150 HP, 1200 RPM, General Electric, squirrel cage.
1—150 HP, 900 RPM, 440 volt, Al. Ch. sl. rg.
1—100 HP, 900 RPM, 440 volt, G.E., sl. rg.
3—100 HP, 720 RPM, 440 volt, G.E., sl. rg.
1—125 HP, 720 RPM, Allis Chalmers, sl. rg.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., sl. rg.
1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.

INSTRUMENTS

25—Westinghouse type U Recording Ammeters with slit core, CT.

25—Westinghouse type U Recording Volt-meters.

MOTORS—3 PHASE 60 CYCLE (Con't)

2—100 HP, 450 RPM, 440 volt, G.E., sq. cg.
1—90 HP, 400 RPM, 550 volt, Cr. Whlr., sq. cg.
1—75 HP, 900 RPM, 4000 volt, Elec. Mach. syn.
1—75 HP, 900 RPM, 220 volt, Fairbanks Morse, slip ring.
1—75 HP, 900 RPM, 440 volt, G.E., sq. cg.
1—75 HP, 720 RPM, 440 volt, Westghse., slip ring.
1—75 HP, 720 RPM, 440 volt, G.E., sq. cg.
2—75 HP, 1200 RPM, 2200 volt, G.E., Vertical.
1—50 HP, 900 RPM, 440 volt, G.E., sl. rg.
1—50 HP, 900 RPM, 440 volt, G.E., sq. cg.

MOTORS—D.C. 230 VOLTS

2—450 HP, G.E., 400 RPM, Type MPL Form 1-F.
1—250 HP, 760 RPM, Electro Dynamic.
2—150 HP, Westghse., 550 RPM, Type SK.
1—150 HP, 750 RPM, Electro Dynamic.
1—125 HP, 600 RPM, Westinghouse, SK.
1—100 HP, G.E., 575 RPM.
1—100 HP, 625 RPM, G.E.
1—80 HP, Crocker-Wheeler, 600 RPM, Type CMC.
1—75 HP, G.E., 575 RPM, Type C, Sprague; with spare armature.
1—65 HP, 1000 RPM, G.E., Type RC.
8—50 HP, Crocker-Wheeler, 700 RPM, Type CM.
1—65 HP, G.E., 625 RPM, Type DLC-65, Form A.
1—50 HP, 750 RPM, Westghse., Type SK.
1—50 HP, 700 RPM, Crocker-Wheeler.
1—40 HP, G.E.-Sprague, 700 RPM, Type LC.
1—40 HP, 775 RPM, Westinghouse.
1—40 HP, 300 RPM, G.E.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, G.E., 750 RPM, Type RC-14, Form A.
1—30 HP, G.E., 1100 RPM, Type RC-31B, Form A-21.
1—35 HP, G.E., 650 RPM, Type RC-15.
1—30 HP, G.E., 625 RPM, Type C.
1—25 HP, Westghse., 600 RPM, Type SK.
2—25 HP, G.E., 775 RPM, Type RC-13.
1—20 HP, G.E., 800 RPM, Type RC-13, Form A.
1—15 HP, G.E., 800 RPM, Type RC-11.

TRANSFORMERS

2—400 KVA, G.E., 4156-250/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—150 KVA, G.E., 33,000/2300/4000 Y.
3—100 KVA Westinghouse, 11,430/250 volts.
1—100 KVA, Pittsburgh, 1375/2750-110/220 volts.
3—100 KVA, Westinghouse, 13200-250 volts.
3—75 KVA, G.E., 13,500-750/440 volts.
3—75 KVA, General Electric, 2200/220/110.
1—75 KVA, G.E., 3 phase, 4156Y—120/208Y.
3—50 KVA, G.E., 2200/220/110.
2—50 KVA, Pbgh. 7500/15000 volts-110/220 volts.
3—37½ KVA, G.E., 2200/220/440.
2—30 KVA, Allis Chalmers, 3 phase, 4156Y/120/208Y
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.

MOTORS—VARIABLE SPEED 230 VOLTS

2—100 HP, 475/1375 RPM, Electro Dynamic.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—35 HP, 500/1500 RPM, Westinghouse.
1—35 HP, 350/1050 RPM, Electro Dynamic.
1—30 HP, 225/900 RPM, Crocker Wheeler.
7—25 HP, Westinghouse, 650/2200 RPM, Type SK-110L.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—15 HP, 300/1200 RPM, G.E.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—5 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker Wheeler.
1—5 HP, 400/1600 RPM, Diehl.
1—5 HP, 225/900 RPM, Electro Dynamic.

TURBO-GENERATORS

600 KW Terry dual bleeder condensing Turbine only.
1—500 KW, G.E., 3 ph., 60 cy., 430 volt, bleeder.
1—375 KVA, Westghse., non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v., cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 v., cond.

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ETC.

BERGER OF ROCHESTER, N.Y.

Put all idle equipment to work. Send your list for prompt action.

TRANSFORMERS

3—500 KVA, GE, type H, form VD525 19100-22000/40000Y to 2300, 1 phase 25 cycle.
1—200 KVA Maloney type H.E. 2400/120/240 volts, 1 phase 60 cycle.
1—200 KVA, G.E., type H.K. 2300/115/230 volts, 1 PH. 60 cy.
2—250 KVA Pittsburgh, 2300/115/230 volts, 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim—6900/2300 volts secondary.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle 3 phase, 450 rpm with direct connected exciter.
200 KW Westh. Unity Power Factor, 3 PH. 60 cyc. 900 R.P.M. with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D, 60, 3 ph., 220/440 600 RPM, revolving field, built-in exciter.
150 K.W. Elect. Mach. Revolving fields 3 Ph. 25 cy. 440 volts 750 R.P.M.
90 K.W. Gen. Elect. Rev. field type A.T.B. .8 P. F. 3 Ph. 60 Cy. 240 Volts 900 RPM. Dir. Con. Exciter.

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115/230 V, 600 RPM.

MOTOR GENERATOR SETS

Western Elect. 1000 Amps — 40 volts direct con. to either AC or DC 580 RPM Motor.
125 K.W. Crocker Wheeler, 250 Volts D.C. Comp. WD. Dir. Con. To G.E. 2300 or 440 Volts Sq. Cage Motor
100 K.W. Gen. Elect. 3 BRG. 125 Volts D.C. Comp. WD. INT. with 220/440 Volts Sq. Cg. Motor.

CRANE MOTORS

75 H.P.—G. E. 51—230 Volts—550 RPM
35 H.P.—G. E. Form D—550 Volts—590 RPM
25 H.P.—Form E—550 Volts—760 RPM

2-Ton Shephard Hoist With 3-H.P. Hoist Motor and 2-H.P. Trolley Motor 3 Phase. Can Be Used Remote Control.

300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle 750 speed 230 volts. With Transformers for 2300 volts.

FREQUENCY CHANGERS

40 KW GE type I.T.T. frame 553 3 ph. 25/62, ½ cy. 220 volts primary 440 volts secondary, 750 RPM direct con. to 40 H.P. GE type KT543—3 ph. 25 cy. 220 volt, 750 RPM.

OTHERS IN ALL SIZES VOLTAGES AND CYCLES

3 ph. 60 cy. A. C. MOTORS

H.P.	Make		Type	Speed	Volts
250	West	S.C.	C.S.	900	440
200	West	Syn.	.08 P. P.	900	220/440
		WITH DIRECT CON. EXCITER			
200	Wsghse.	Sl. Rg.	CW	600	220/440
200	Gen. Elec.	Sq. Cg.	1 Form K	514	220/440
200	Gen. Elec.	Syn.	ATi	514	4000/2300
175	Ideal	Sl. Rg.	AVA	1750	2200
150	Gen. Elec.	Sq. Cg.	I	600	2300
150	Al Ch	Sq. Cg.		600	440
150	Burke	Sq. Cg.	3 BRG. 2 ph	900	220/440
125	Gen. Elec.	Sl. Rg.	NT. 553	1200	220
125	Gen. Elec.	Sq. Cg.	I K	720	220/440
25	Gen. Elec.	Sq. Cg.	I. K. Vert.	720	220

3 ph. 25 cy. MOTORS

H.P.	Make		Type	Speed	Volts
830	Elect. Mach.	Syn.	Dir. Con. Exc.	500	2300
350	Gen. Elec.	Sl. Rg. 3 Brg.	I	375	440
200	Lincoln	S. R.	I. X. W.	500	440
150	Burke	Syn.	Dir. Con. Exc.	500	440
150	Gen. Elec.	Sl. Rg.	I Form M	500	2200
100	Wagner	Sl. Rg.	BR	750	220/440
100	Gen. Elec.	Sl. Rg.	I Form M	750	220/440
100	Gen. Elec.	Sq. C.	I K	750	220/440
100	Wsghse.	Sq. C.	CSJ	500	220/440
75	Wsghse.	Sq. C.	CCL	500	220/440
75	Gen. Elec.	Sl. Rg.	I M	750	220/440
75	Wagner	Sq. C.	BM	750	2200
75	Gen. Elec.	Var.	BTA	375/750	440
50	Burke	Syn.	AC 133	750	220
		WITH DIRECT CON. EXCITER			

230V D. C. MOTORS

H.P.	Make	Type	Speed
150	West	SK 180L Comp. Wd. Int.	1150
125	G.E.	CL	850
100	Northwestern	K30 Comp. Inter.	1750
85	Gen. Elec.	Vert. Comp. Wound	750
75	Crocker Wh.	CCM25JA	1700
67	Otis	Elevator Motor Comp. wd.	1200
60	Sprague	D—Comp. Wound	625
50	Gen. Elec.	C. L. 6 Shunt Wound	500
40	Fair. Morse	Ball BRG. Vert. Comp.	1740
32	Sturdevant	C Form P. Shunt Wound	1150

Only partial listing

OVER 10,000 ITEMS IN STOCK FOR IMMEDIATE DELIVERY FROM EITHER ROCHESTER, N. Y. OR TOLEDO, OHIO REBUILT AND SOLD WITH A STANDARD NEW GUARANTEE.

Write or wire your inquiries

BERGER BROTHERS ELECTRIC MOTORS, Inc.
395 STATE ST.
ROCHESTER NEW YORK

THE FRED W. KIEMLE CO.
33 N. SUPERIOR ST.
TOLEDO OHIO

The BIG Battles
The BIG LOSSES
The BIG VICTORIES
are still ahead!

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WIN THE BATTLES AND LESSEN THE LOSSES WITH

• PAUL STEWART •

HEAVY POWER PLANT EQUIPMENT

WATER TUBE BOILERS

1—100,000/120,000# T.S.G. Straight Tube Sectional Steel Header Cross Drum 250# unit, 125° Superheat, steel encased, underfeed ram type stoker fired; complete going installation.

1—80,000/90,000# T.S.G. Bent Tube 350# ASME steel encased unit, designed for powder fuel firing and complete with all modern auxiliaries.

4—1000 HP Box Steel Header Straight Tube Longitudinal 3 Drum type 250# ASME 125° Superheater equipped, oil fired units; complete with all paraphernalia for re-installation.

2—750 HP Box Steel Header Straight Tube Longitudinal type 2 Drum Edgemoor units, 200#; steel encased, waste heat fired.

1—612 HP B&W Stirling 200# ASME unit, complete with all auxiliaries, self-supporting members, stoker and stack.

4—600 HP B&W Stirling units almost mate duplicates to the above unit; original design pressure 200#, now hand fired.

1—508 HP Babcock & Wilcox Serpentine Steel Sectional Header Longitudinal Drum type unit, 200#, complete with all auxiliaries and stoker.

2—500 HP Edgemoor Box Steel Header 200# design units, complete with superheaters and underfeed stokers for re-installation.

2—300 HP Heine Marine type Cross Drum Steel Encased 200# ASME hand fired units, with one stack and all trimmings.

TURBOS — 60 Cycles

15000/19000 KVA Impulse and Reaction Design Condensing Turbo unit, 250#, 150° Superheat, 60/3/13,200; complete going unit including surface condenser, all auxiliaries and piping.

1—5000 KW/6250 KVA Curtis General Electric multi-stage Condensing Turbo unit, 200/225#, 125° Superheat, 60/3/2300/3600; complete with surface or jet condenser.

2—4000 KW/5000 KVA Curtis General Electric six-stage Condensing Turbo units, 60/3/2300/1800; complete with surface or jet condenser.

1—2500 KW/3125 KVA Curtis General Electric four-stage Condensing Turbo unit, 60/3/4100 (Star regroupable Delta 2300 V), 200#, 100° Superheat; complete with surface condenser.

2—2000 KW/2500 KVA Westinghouse Straight Parsons design Non-condensing Turbo units, 60/3/2300/3600, 200#, 15/20# gauge back pressure.

2—1000 KW Westinghouse Multiple Expansion Parallel Flow Condensing Turbo units, 60/3/2300/3600; complete with surface condensers.

1—500 KW Westinghouse modern Impulse and Reaction Single Flow Steel Barrel Condensing Turbo, 200/250#, 60/3/2300/3600; complete with jet condenser.

1—500 KW Westinghouse Parsons Multiple Expansion Parallel Flow Turbo unit, 60/3/220 or 440/3600.

1—500 KW Westinghouse Parsons Multiple Expansion Parallel Flow Condensing Turbo unit, 60/3/2300/3600; with surface condenser.

2—300 KW Westinghouse Condensing Turbo units, 60/3/2300/3600; complete with jet condensers.

1—300 KW Westinghouse type ENC Single Wheel Re-entry type Condensing or Non-condensing Turbo unit, 60/3/220 or 440/3600; rebladed, rebuilt and rewound complete.

HEAVY POWER DELIVERY THRU 3 WARS

COMPLETE DATA SENT ON REQUEST

MAY WE CONFIRM INTENT AND ABILITY—FACE TO FACE!

SPECIAL POWER PLANT EQUIPMENT

6250 KVA Westinghouse Turbo-Generator Set: Turbine 3600 RPM, 200 lbs pressure, 125° Superheat, complete with condenser, Pump and Air Washer. Generator: 6250 KVA 3 Phase 60 Cycle 2300 Volt 3600 RPM with turbo exciter and Motor Generator Exciter.

MOTORS

230 VOLT DC

CONSTANT SPEED

Qu.	H.P.	Make	Type	RPM
1	450	Al. Ch.	Int	425
1	125	G.E.	DLC	550
1	100	Al. Ch.	CPD Int	1000
1	100	Rel.	1050T	500
1	75	G.E.	DLC	525
2	50	West.	SK160	565
1	40	G.E.	RC15A	700
1	30	West.	SK120	975
2	30	G.E.	RC31B	1150
1	30	West.	SK140	600
2	25	West.	SK120	825
8	25	G.E.	RC31	1150
1	25	West.	SK	850
1	20	G.E.	RC11	1150
3	15	G.E.	RC10	1150
5	15	West.	SK 100 I	675
7	15	Rel.	92 T TE.BB	850
2	15	West.	SK90	850
4	15	G.E.	RC11	850
3	10	G.E.	RC29	1150
8	10	G.E.	RC29	850
3	10	West.	SK80	750
2	7½	G.E.	RC	1150
9	5	West.	SK40	850

VARIABLE SPEED

Qu.	H.P.	Make	Type	RPM
3	150	Diehl	K15	400/800
1	110	West.	SA	650/1050
1	100	West.	SA	250/350
1	75	G.E.	LC	650/900
2	40	G.E.	LC	650/1300
3	30	West.	SK140	600/1200
1	25	West.	SK	400/1200
1	15	West.	SA9	300/1200
1	15	West.	SK103	400/1600
2	15	West.	SK	500/1500
2	10	Al. Ch.		500/1000

SQUIRREL CAGE

A.C. 3 PH. 60 CYCLE 2300 VOLT

Qu.	H.P.	Make	Type	RPM
1	150	G.E.	IK	900
1	100	West.	CS774C	900
1	100	G.E.	IK	514

220/440 VOLT

Qu	HP	Make	Type	RPM
2	250	Gen. Elec.	IK	1760
1	200	Al. Ch.		1750
1	125	Cr. Wh.	125Q	900
1	75	Al. Ch.	Splash proof	1200
1	75	Al. Ch.		600
1	50	Wagner	22 VRM	600
1	50	Gen. Elec.	KT	900
1	40	Rel.		900
5	30	Wagner	19 VRM	720
2	25	Al. Ch.		860
2	20	Al. Ch.		1740
2	20	Rel.	120 AA	900
1	20	Rel.	178 AA	720
1	15	Gent.	SCN 19	1200
1	15	Gen. Elec.	KT	900
3	10	Gen. Elec.	KT	1200
1	7½	Al. Ch.		1150
1	5	Al. Ch.		860
3	3	Imp.	TE BB	3600
1	1½	Gen. Elec.	K	1720
5	1	Wagner	BB	1200

MAGNETIC STARTERS

2 to 50 HP. 230 V. DC. Large Stock specially priced.

TRANSFORMERS

60 CYCLE, SINGLE PHASE

3—333 KVA G.E. 2300/440/220 oil.
3—100 KVA Pittsburgh 2400/240/120 oil.
4—5 KVA Wsghse. 2300/230/460 air.
8—3 KVA G.E. 2300/230/115.

WATER WHEELS and GENERATORS

2—45" HERCULES Cylinder Gate Type B Water Wheels. Complete with Governors, pumps, and tanks. Each direct-connected to a WESTINGHOUSE ELECTRIC Vertical Generator 800 KVA, 3 ph., 600 V. 40 cy. 150 R.P.M.

GENERATORS
230 VOLT DIRECT CURRENT

750 KW Ridgway 1800 RPM Cpd. Int.
100 KW Ft. Wayne MPL 550 RPM.
100 KW G.E. MPL 600 RPM.
200 KW Sprague 525 RPM.
200 KW West. 500 RPM.
250 KW West. 500 RPM.

MOTOR GENERATOR SETS

50 KW Westnghs. 125 V. DC. 900 RPM. direct conn. to 75 HP. 440-3-60 Motor.
35 KW G.E. 125 V. DC. 1200 RPM. direct conn. to 50 HP. 2300-3-60 Motor.

BOILERS

4—1010 HP. Heine Watertube Boilers complete with Superheaters, Bethlehem Dahl Oilburners, all valves, Piping and fittings.
2—684 HP Edgemoore Waste Heat Boilers 200 lbs. pressure with Economizers, super-htrs., motor driven blowers and steel stacks.
2—500 HP. Edgemoore 200 lbs. press. ASME Code, with Riley side dump stokers.
2—316 HP. Heine Watertube Boilers 160 lbs. pressure.

STOKERS

UNDERFEED

2—West 7 Retort 700 HP. rated capacity
1—Jones 3 hetort 316 HP. rated capacity.
Steam actuated. Will operate at 200% of rated capacity.

CONDENSER

1—C. H. Wheeler 3650 Sq. Ft. Surface Cond. 2 pass. complete with pumps.

SPEED REDUCERS

6—Jones Herringbone 50 HP. Ratio 93.5 to 1.
1½ HP. G. & F. Worm Gear Type, ratio 10.20 to 1.
15 HP. DeLaval Worm Gear Reduction. Unit ratio 12 2/3 to 1.

TURBO-CENTRIFUGAL PUMPS

Terry Steam driven Turbine centrifugal pump, type GF, turbine 710 H.P., 145 lb. steam pressure, 60 lb. back-pressure, 3581 RPM direct connected thru Gear Unit 1000 RPM; type U Allis Chalmers Centrifugal Pump 18" x 18", 13,000 GPM at 170' head, 1000 RPM.
1—Lawrence Machine 3 stage pump 550 GPM, 416' head. With Elliott Turbine, 200 H.P., 2400 RPM, 170 lbs. initial, 12 lbs. back pressure
1—Lawrence Machine 8" Circulating Pump. With Lee Turbine, 50 H.P., 2100 RPM, 150-250 lbs. initial, 10 lbs. back pressure
1—Lawrence Machine 6" Circulating Pump. With London Steam Turbine, 40 H.P., 2200 RPM, 150 lbs. initial, 10 lbs. back pressure
1—Lawrence Machine 5 stage pump 150 GPM, 635' head. With Lee Turbine, 80 H.P., 2600 RPM, 200 lbs. initial, 10 lbs. back pressure
1—Lawrence Machine 5 stage pump 200 GPM, 635' head. With Lee Turbine, 85 H.P., 2650 RPM, 175 lbs. initial, 10 lbs. back pressure

PUMPS OR TURBINES MAY BE PURCHASED SEPARATELY

CENTRIFUGAL PUMPS

2—Lecourtenay 5" all bronze centrifugal pumps 500 GPM at 90' head direct connected to Allis-Chalmers 20 H.P. Motor 440, 60, 3, 1740 RPM.
2—Lecourtenay 12" Iron Casing Motor Driven Centrifugal Pumps, type 12BT8, 5,000 GPM at 148' H., Direct connected to G.E. 250 HP. Motor, type I, E15 form K, 440, 60, 3, 1760 RPM.
Lecourtenay 12" Iron Casing Motor Driven Centrifugal Pump, 4,500 GPM at 185' H. 1750 RPM Direct Connected to Allis-Chalmers 200 H.P. Motor 440, 60, 3, 1750 RPM.
8—Gould Centrifugal Pumps 270 GPM. 30' M. Direct Driven by 5 H.P. A.C. Motor.
Cameron Centrifugal Purchased New 1923. Bronze fitted, mounted on common subbase for motor drive—
1—Size 14—700 RPM 4700 GPM 35' head 60 H.P.
1—Size 14—720 RPM 3500 GPM 30' head 75 H.P.
1—Size 16—350—RPM 3500 GPM 45' head 125 H.P.
All Pumps Tested Hydrostatically for 125 lbs.
All Double Suction Volute, Gate Valves Attached.
1—Gould Triplex Pump 5 x 8.

STEEL STORAGE BINS

Size up to 35,000 cbft.

CONVEYORS AND BUCKET ELEVATORS

MISCELLANEOUS

STEEL TANK: 360,000 Gal. Water Storage 40' Diameter by 40' high.
FEEDWATER HEATER: 5,000 HP. Cochrane open type.
OVERHEAD CRANES: One 25 Ton overhead hand-operated.
One 15 Ton overhead 50' span traveling crane, electric lift; hand travel.

HEAT and POWER Company

45 BOND STREET **Phone: Algonquin 4-3874** **NEW YORK 12, N. Y.**

REBUILT POWER EQUIPMENT

READY TO SHIP!

AIR COMPRESSORS

1—599 CFM Ing. Rand Imperial 10, XB-2 horiz. 2 st. duplex, 100 lbs. pres. with A.C. mtr.
1—725 CFM Nat'l Brake, type 3VD, 100 lbs. pres., single stage, complete with A.C. mtr.

MOTOR GENERATOR SETS

1200 kw. G.E. 275 v. 720 rpm., 4100 v., 3 ph. 60 cy. syn.
1000 kw. G.E. 250 v. 720 rpm., 4150 v. 3 ph. 60 cy. syn.
1—150 KW Ridgway 250 v. 900 rpm. 2200 v. 3 ph. 60 cy. syn.
1—150 kw. Crocker Wheeler 250 v. DC, 600 rpm. dir. con. to 220/440 or 2200 v. syn. motor.

A.C. GENERATORS

1—62½ KW Westg. 2300 v. or 220/440 3 ph. 60 cy. 1200 rpm.
1—125 KVA Westg. 2200 v. 3 ph. 60 cy. 327 rpm.
1—150 KVA Wagner 220/440 v. 3 ph. 60 cy. 600 rpm.

TACHOMETERS

2—Brand New, Model C Hickok Generators, 0/2000 rpm., flexible couplings, Hickok model meters—2000 rpm.

SCALES

9—Howe Scales—3 beams (2 at 200 lb. ea.—1 at 50 lbs.) Platform 14½x22", Approx. capacity 500 lbs.

25 CY. MOTORS—220/440 V. A.C.

HP	Make	Type	RPM
52	G.E.	ITC	750
40	Al. Chal.	AN	750
35	G.E.	I-M	500
30	Al. Ch.	AN	750
25	Westg.		750
7½	Westg.		705
3	G.E. (1 ph.)	SCR	1500
1	Westg. (vert.)	CSA	750

SLIPRING MOTORS—3 PH., 60 CY.

HP	Make	Type	Volts	RPM
350	Westg.	CW	2200	900
260	Burke]	EMV-65	220/440	600
250	Westg.	CW	2200	345
150	G.E.	I-M	220/440	720
150	G.E.	MT	220o	1200
100	G.E.	IM	220/440	900
100	G.E.	IM	2200	450
75	Westg.	CW	220/440	690
75	G.E.	I	220/440	900
75	G.E.	ITC	220/440	1800
62	Westg.	CW	220/440	1135
60	Triumph	C-16	220/440	430
52	G.E.	ITC	220/440	900
50	Al. Chal.		220/440	490
50	Westg.	HF	220/440	860
50	G.E.	enc.	220/440	1200
50	Westg.	CW	220/440	1150
50	Chandeysson		220/440	1800
40	G.E.	MT	220/440	720
40	G.E.	MT	220/440	1200
20	Cr. Wh.		220/440	850
15	G.E.	IM	220/440	850

A.C. MOTORS—3 PH., 60 CY.

HP	Make	Volts	RPM	Type
2000	G.E.	2200	240	TS-syn
1500	G.E.	2200	225	ATI-syn
1000	G.E.	2300	509	K
250	G.E.	220	720	IK
209	G.E.	220	514	IK
200	Westg.	220/400	580	CS
200	G.E.	220/440	720	IK
150	Westg.	2200/440/220	327	syn
150	G.E.	220	450	IK
150	G.E.	440	514	IK
150	G.E.	550	575	IK
150	G.E.	220	575	
150	G.E.	440	600	IK
125	Cr. Wh.	220	720	
125	G.E.	220	400	IK
125	G.E.	440	450	IK
125	G.E.	440	514	IK
125	Al. Ch.	220	800	
100	G.E.	440	400	IK
100	Cr. Wh.	220/400	575	
100	Westg.	220/440	700	CS
100	G.E.	550	900	IK
75	Cr. Wh.	220	514	
75	Westg.	220	600	CS
75	G.E.	550	720	IK
75	Cr. Wh.	550	900	
75	G.E.	220/440	1150	
75	Westg.	2200/220/440	1200	
75	Al. Ch.	220/440	1800	AN
65	G.E.	220/440	1200	IK
65	Al. Chal.	220/440	1800	AN
75	Louis Allis	220/440	170/1770	
60	Triumph	220/440	430	
60	G.E.	550	600	IK
60	Cr. Wh.	220	670	
60	Westg.	220	720	CS
60	Al. Ch.	440	1200	AN
60	Al. Ch.	220/440	1800	AN
54	Al. Ch.	220/440	900	
50/32	G.E.	220/440	800/640	POS
50/100	West.	220/440	345/700	CS
50	G.E.	220/440	400	IK
50	G.E.	220/440	450	IK
50	Westg.	220/440	514	CS
50	Westg.	220/440	600	
50	Westg.	220/440	690	
50	Westg.	220	720	CS
50	Westg.	220/440	850	
50	Amer. (vert.)	440	900	
50	Reliance	220/440	1200	
50	G.E.	220/440	1200	IK
50	Al. Cha.	220/440	1800	AN
40	G.E.	220/440	360	IK
40	Westg. (totally enc.)	220	600	CS
40	Amer. (vert.) (fan cooled, totally enc.)	220/440	685	
40	Amer. (enc. ball bearing)	220/440	685	PK
40	Reliance	220/440	900	
35	Westg.	220/440	514	CS
35	Lincoln	220/440	720	
35	G.E.	220/440	900	
35	G.E.	220/440	1200	IK
35 (new)	Westg.	220/440	1800	CS
30	Amer.	220/440	600	
30	G.E.	220	900	I
30	Triumph	220	1200	
25	Triumph	220	850	
25	Westg.	220/440	1200	CS
1½	Ilg.	220	490	
½	G.E.	220	1200	
½	G.E.	220	900	K

VARIABLE SPEED MOTORS—230 V. D.C.

HP	Make	Type	RPM
250	Cr. Wh.	CMC	200/400
75	Westg.	SK-181	400/800
35	Westg.	SK-140	675/1350
30	G.E.	RLC	450/900
20	Westg.	SK-110L	750/1500
20	Westg.	SK-100L	900/1800
15	Louis Allis		1150/1750
15	Westg.	SK-90	850/1700
10	Westg.	SK-111	300/1200
10	Westg.	SK-70	850/1700
10	G.E.	LC	625/1250
10	Westg.		565/1130
7½	Westg.	SK-111	200/1200
7½	Cr. Wh.		385/1155
5	Reliance	F-21	300/1800
3 75	Westg.	SK-111	300/1200
3¼	Westg.		400/1600
3	Jantz-Liest		650/1950
2½	G.E.	RLC	500/1000

TRANSFORMERS—1 ph. 60 cy.

No.	Kva.	Pri.	Sec.	Make	Ph.
1	250	2300	460	G.E.	
1	100	2200	110/220	G.E.	
3	100	6600	550/440/220	Pgh.	
2	75	2200	200	Burke	ph.
2	50	2300	220/440	G.E.	
3	50	11430/6600	550	Al. Ch.	
3	50	6600	575	G.E.	
1	37½	2300	220/440	Wagner	
3	37	4400	185	West. (Rotary)	
1	30	2200	110/220	G.E.	
40	10	2200	110/220	West.	
100	7½	2200	110/220	G.E.	
50	5	2200	110/220	G.E.	
75	5	2200	110/220	West.	

INDUSTRIAL TRUCKS

1—Baker Tow Truck with batteries.

PUMPS

2—#7 Blackmer Rotary Pumps 24' hd. 25 gpm.
2—New Moyno Pumps 2x2, 40 gpm., 100' hd.
2—New Wilfrey 2x1½—50 gpm.
1—100 gpm. American 5 hp. motor Portable
1—2500 gpm. Allis Chal. 95/125' hd.

SPEED REDUCERS

.55 Link Belt ratio 342:1
3 HP. Boston ratio 900:1
3 HP. Link Belt triple reduction herringbone ratio 221:1
3 HP. Farrel double reduction ratio 19:1
5 HP. Boston ratio 32:1
5 HP. Link ratio 17:1
7½ HP. Boston ratio 32:1
10 HP. Link Belt 17:1
10 HP. Boston ratio 32:1
300 HP. Nuttal ratio 1.6:1

CHAIN BLOCKS—with or without trolleys

2—Chisholm Chain Blocks 2 tons
2—Ford Triblock—2 ton
4—Ford Triblock—3 ton
1—Phila.—3 ton

HOISTS

2—New Shaw Monorail Load Lifters—2000 lbs.—25' lift, 2 HP. A.C. Motors, push button control
1—2 ton Shepard 230 v. D.C. complete with trolley and cable.

INDUCTION MOTOR GENERATOR SETS

250 Volts Compound Wound, D. C. — 3 Ph., 60 cy. Motors

KW	Make	RPM	AC Volts
2	Crocker Wheeler	1750	220/440
3	Westinghouse	1150	220/440
5	Allis Chalmers	1150	220/440
7½	Allis Chalmers	1150	220/440
25	Westinghouse	1150	220/440/550
10	General Electric	1150	220/440
15	Westinghouse	1150	220/440
20	Westinghouse	1150	220/440
35	Westinghouse	850	220/440
90	Reliance	1150	220/440
110	Crocker Wheeler	720	2200/440/550
150	Crocker Wheeler	580	220/440
75	Westinghouse	435	2200
75	Westinghouse	435	440/220

Large Stock—CIRCUIT BREAKERS—METERS — CURRENT AND POTENTIAL TRANSFORMERS—POTHEADS—RELAYS—METERS — SAFETY SWITCHES — DISCONNECT SWITCHES — U-RE-LITES — PULLEYS — REACTORS.

WRITE, WIRE OR PHONE YOUR ELECTRICAL REQUIREMENTS—SEND FOR STOCK LIST.

LIST YOUR IDLE EQUIPMENT WITH US.

DUQUESNE ELECTRIC & MFG. CO.

PITTSBURGH 6, PA.

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.

1—15300 KVA Westinghouse Cond.
1— 6250 KVA General Electric Cond.
1— 4000 KW General Electric Cond.
1— 4000 KVA Allis Chalmers Cond.
1— 3125 KVA General Electric Cond.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA Allis Chalmers Cond.
1— 2500 KVA Westinghouse Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA General Electric Cond.
1— 1250 KVA General Electric Non-C.
1— 938 KVA West. 375# I.P. 100 B.P. N-C.
1— 625 KVA General Electric Non-C.
1— 500 KVA Westinghouse Non-C.
1— 470 KVA Westinghouse Non-C.
1— 312 KVA Moore Non-Condensing
1— 250 KVA Westinghouse Non-C.
1— 125 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 375 KVA Nordberg Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Hamilton 4-valve
1— 210 KVA Skinner Uniflow
1— 187 KVA Skinner Uniflow
1— 150 KVA Skinner Uniflow
1— 100 KVA Skinner Uniflow
1— 94 KVA Ridgway 4-valve
1— 93.8 KVA Skinner Uniflow
1— 60 KVA Skinner Uniflow

D.C. STEAM ENGINE UNITS

1—350 KW Ridgway 4-valve 250 V.
1—300 KW Skinner Uniflow 250 V.
1—250 Ames Uniflow 250 V.
1—150 KW Ames Uniflow 125 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire
1—100 KW Ames Uniflow 120 V.
1—100 KW Elliott 4-valve 250 V. 3-wire

OIL & GAS ENGINE UNITS—60 Cy.

1—622 KVA Worthington 240 V.
1—520 KVA West.-Campbell 2300 V.
1—500 KVA West. (gas) 440 V.
1—500 KVA Busch Sulzer 2400 V.
1—425 KVA Worthington 240 V.
1—312 KVA Anderson 2400 V.
1—300 KVA Fairbanks Morse 2400 V.
1—240 KVA Worthington 2300 V.
1—200 KVA Fairbanks Morse VA 2400 V.
1—187 KVA McInt.-Seymour 2300 V.
1—156 KVA Cooper Bessemer 240 V.
3—143 KVA Cooper Bessemer 220 V.
1—125 KVA Sterling Petrel (gas) 480 V.
1— 75 KVA General Motors 120/208 V.
1— 37.7 KVA Caterpillar 120/208 V.

SURFACE CONDENSERS

1—20,000 sq. ft. Worthington
1—12,000 sq. ft. Worthington
1— 5,000 sq. ft. Westinghouse
1— 4,100 sq. ft. Ross
1— 2,310 sq. ft. Wheeler C. & E.

WATER TUBE BOILERS

1—750 HP Edge Moor 200-lb.
1—612 HP Stirling 250-lb., Pulverizer
2—612 HP Stirling 200-lb., Stokers
1—600 HP Union 250-lb., Stoker
2—560 HP Erie City 460-lb.
1—500 HP Stirling 250-lb., Stoker
1—500 HP Stirling 200-lb., Stoker
1—400 HP Wickes 200-lb., stoker
1—335 HP B. & W. 200-lb.
2—300 HP Heine 200-lb.
4—200 HP B. & W. 200-lb., Hand Fired

A. C. GENERATORS

2—1500 KVA G.E. 25 cy. 2200 V. 750 RPM
2—1250 KVA G E. 60 cy. 480 V. 750 RPM
1— 750 KVA G.E. 60 cy. 230-460 V. 300 RPM
1— 680 KVA G.E. 25 cy. 13200-4000 V. 300 RPM
1— 500 KVA G.E. 60 cy. 2300 V. 360 RPM
1— 360 KVA West. 60 cy. 240 V. 360 RPM
1— 94 KVA G.E. 60 cy. 2300 V. 600 RPM
1— 48 KW Elec. Mcy. 60 cy. 2400 V. 1200 RPM

SYNCHRONOUS MOTORS

2—1250 HP G.E. 25 cy. 2200 V. 750 RPM
2—1125 HP G.E. 60 cy. 480 V. 720 RPM
1— 850 HP G.E. 25 cy. 13200-4000 V. 300 RPM
1— 800 HP G.E. 60 cy. 440 V. 120 RPM
1— 770 HP G.E. 60 cy. 230-460 V. 300 RPM
1— 620 HP G.E. 60 cy. 440 V. 164 RPM
1— 150 HP West. 60 cy. 2200 V. 600 RPM
1— 100 HP G.E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

4—3500 HP G.E. slip ring 2300 V. 120 RPM
1—1000 HP G.E. sq. cage 2300 V. 509 RPM
1— 600 HP G.E. sq. cage 440 V. 900 RPM
2— 400 HP G.E. slip ring 3800 V. 1800 RPM
2— 300 HP G.E. sq. cage 440 V. 600 RPM
2— 250 HP G.E. sq. cage 2300/4000 V. 1200 RPM

MOTOR GEN. SETS—60 Cy.

1—1500 KW Allis Chalmers 600 V. DC
1—1000 KW General Electric 600 V. DC
1—1000 KW Westinghouse 250 V. DC
1— 75 KW General Electric 125 V. DC
2— 75 KW Westinghouse 125 V. DC

ROTARIES—60 Cy.

1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
2— 750 KW General Electric 600 V.
1— 750 KW Westinghouse 225/275 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.

FREQUENCY CHANGERS

2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA G.E. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1875 KVA G.E. 25/60 cy. 300 RPM
2—1250 KVA G.E. 25/62½ cy. 750 RPM
1—1250 KVA G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 25/60 cy. 300 RPM
1— 750 KVA G.E. 60/25 cy. 300 RPM

SYN. CONDENSERS—60 Cy.

1—5000 KVA West. 5000 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
2—1250 KVA G.E. 480 V. 720 RPM
1— 750 KVA G.E. 230-460 V. 300 RPM
1— 500 KVA West. 2200 V. 900 RPM

TRANSFORMERS—1 Ph. 60 Cy.

1—10000 KVA West. 120,000/66000-13200 V. 3 ph.
3— 750 KVA Pitts. 66000/33000 V.
3— 200 KVA G.E. 66000-13200/22800 V.
6— 250 KVA Penn. 34500-4600/2300 V.
4— 150 KVA Pitts. 33000-2300/4600 V.
3— 75 KVA G.E. 33000-13200/11000 V.
2—10000 KVA West. 26400-4580 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
1— 6000 KVA West. 13200-2300 V. 3 ph.
3—1500 KVA Pitts. 22000-6600 V.
2—1000 KVA G.E. 23000/11500-575 V.
6— 833 KVA G.E. 22000-2300/4000 Y V.
3— 667 KVA Packard 23000-440 V.
3— 250 KVA G.E. 22000-11000 V.
6—1667 KVA Pitts. 13200-2300 V.
5—1000 KVA G.E. 13200-2300 V.
3— 200 KVA G.E. 13200-2300 V.
7— 667 KVA Moloney 11000-2300 V.
3— 150 KVA Pitts. 11000-2400 V.
3— 100 KVA West. 11000-250/125 V.
3—1250 KVA G.E. 6600-550 V.
3— 150 KVA Al. Ch. 2400/4800 V.

VOLTAGE REGULATORS
60 Cycle Induction

6—96 KVA 400 A. 2400 V. Gen. Elec.
1—72 KVA 300 A. 2400 V. Gen. Elec.
2—46 KVA 200 A. 2300 V. West.
6—36 KVA 150 A. 2400 V. Gen. Elec.
6—24 KVA 100 A. 2400 V. Gen. Elec.

OIL CIRCUIT BREAKERS

2— 400 A. 73 KV G.E. FKO36 Outdoor
1— 400 A. 73 KV G.E. FHKO36 Outdoor
1— 800 A. 37 KV G.E. FHKO136 Outdoor
6— 400 A. 37 KV G.E. FHKO136 Outdoor
4— 400 A. 34.5 KV Condit D-16-A Outdoor
2—1000 A. 30 KV Kelman CB76 Outdoor
4— 600 A. 15 KV G.E. FKO60B Outdoor
2— 400 A. 15 KV G.E. FHKO136 Outdoor
2— 600 A. 25 KV West. B-13 Indoor
1—2000 A. 15 KV West. E6 Indoor
1—1500 A. 15 KV West. E6 Indoor
2—1500 A. 15 KV G.E. FK12 Indoor
3— 600 A. 15 KV G.E. FK32C Indoor
6—1200 A. 4.5 KV Condit D-12 Indoor
2—1000 A. 4.5 KV Condit D-12 Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 CHURCH STREET, NEW YORK CITY 7, NEW YORK

PARTIAL LIST OF OUR COMPLETE STOCK FOR IMMEDIATE SHIPMENT

PUMPS

G.P.M.	Head	Make	Type
9700	110′	Ing. Rand	Centrif.
6000	33′	LeCourtenay	Centrif.
3500	140′	Kingsford	Centrif.
2500	150′	Goulds	Centrif.
1100	220′	Allis-Chalm.	Centrif.
1000	176′	Cameron	Centrif.
400	625′	LeCourtenay	Centrif.
250	525′	LeCourtenay	Centrif.
300	500′	Goulds	Triplex
175	500′	Worth.	Triplex
500	175′	Blackmer	Rotary
450	231′	Kinney	Rotary
200	175′	Blackmer	Rotary
1000	460′	Knowles	Steam
500	460′	Knowles	Steam
2000	50′	Lawrence	Sump
300	231′	Gardner	Plunger

STEAM ENGINE GENERATOR SETS
BOILER FEED PUMPS

K.W.	Make	Volts	Type
100	Ames	240	dir. dr. Eng.
75	Ames	120–240	dir. dr. Eng.
50	G.E.	250	dir. dr. Eng.
35	Sturt.	250	belt dr.

MOTORS (D. C.)

100	Northwest	220 1750
25	Imperial	220 450

STORAGE TANKS

5 to 30000 Gal. Steel Welded
5 to 1000 Gal. Steel Press.
15 to 300 Gal. Conden. Tanks

CONDENSATION RETURN UNITS

Nash-Jenn Dup. Vac. Heat. 26000EDR
Nash-Jenn Sump Vac. Heat. 16000EDR
Skidmore Vac. Heat. 8000EDR
Condensation Units 100 to 250,000EDR

AIR COMPRESSORS

C.F.M.	Pressure	Make	Type
850	100	Laidlaw	Hor. Dup.
500	60	Ind. Rand	Steam
400	125	American	Horiz.
350	40	Worthing	Horiz.
250	100	Sullivan	Horiz.
220	100	Gardner	Gas Eng.
28	500	Norwalk	4-Stage

TURBO-CENTRIFUGAL BLOWERS

3000	16 lbs.	In. Rand	Motor dr.
2300	3 lbs.	Spencer	Motor dr.
950	24 oz.	Spencer	Motor dr.
900	5¼ lbs.	In. Rand	Motor dr.
700	2½ lbs.	Allen Billmyer	Motor dr.
675	24 oz.	Spencer	Motor dr.
250	16 oz.	Spencer	Motor dr.

BLOWERS

C.F.M.	St. Pres.	Makes	Type
100–60000	¼"–5"	Buffalo	Various
100–15000	¼"–16 oz.	American	Various

ROTARY PRESSURE BLOWERS

C.F.M.	Press.	Make	Type
10000	2 lbs.	Roots	Belt dr.
6000	3 lbs.	Roots	Belt dr.
3000	3 lbs.	Roots	Belt dr.
2000	3 lbs.	Sturt.	Belt dr.
1000	3 lbs.	Roots	Belt dr.
200	5 lbs.	Baker	Dir. dr.
110	15 lbs.	Beach R.	Belt dr.

VACUUM PUMPS

1000	15 in.	Roots	Belt dr.
350	27 in.	Worth.	Belt dr.
300	27 in.	Nash	Belt dr.
100	27 in.	Deane	Belt dr.
200	29 in.	Devine	Belt dr.

MOTORS (3 ph. 60 cy.)

H.P.	Make	Volts	Speed	Type
300	G.E.	2300/4000	1800	Syn.
175	G.E.	440	1150	I
100	Lincoln	220	1750	
75	Wagner	440	1750	
50	Wagner	220	850	Syn. 2 ph
50	G.E.	2300	1750	I
50	West.	220	850	CCL
50	West.	220	570	CS
40	G.E.	220	870	342
30	Wagner	220	850	sl. rg.
30	Wagner	220	1150	

SIMILAR EQUIPMENT IN STANDARD MAKES AND SMALLER SIZES
HIGHEST PRICES PAID FOR YOUR IDLE EQUIPMENT

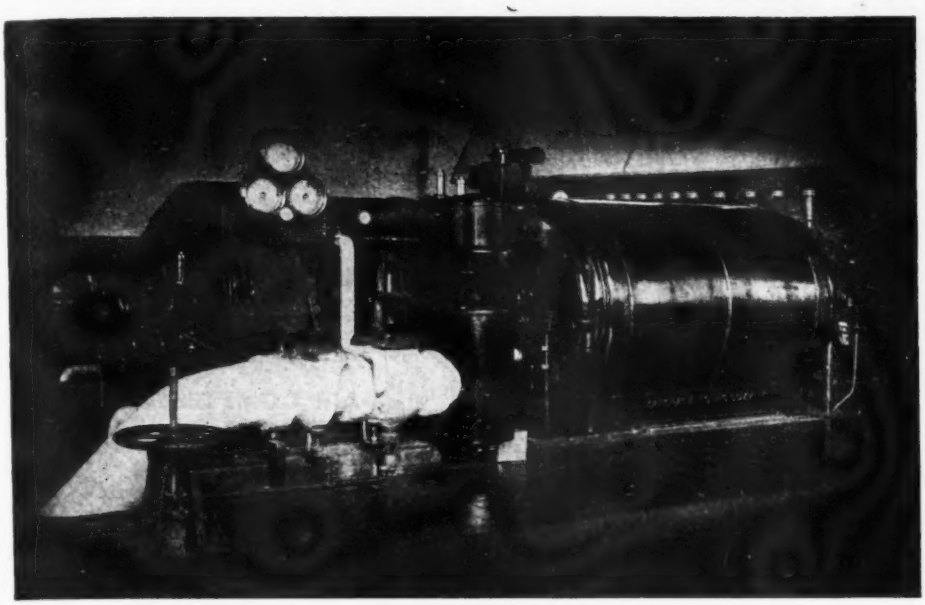
STEAM ENGINES

Turb. Cent. Bronze Pumps
Valves—Reducing Valves
10"x10" Greenfield Vertical
7"x7" Wickes Bros. Vertical
6"x6" Lawrence Vertical
1 to 40 H.P. Steam Turbines

SUPERIOR EQUIPMENT CO.

140 Grand St., N. Y. C. Tel. CAnal 6-6983-4

3125 KVA CONDENSING TURBINE-GENERATOR UNIT



ACTUAL PHOTOGRAPH

AVAILABLE IMMEDIATE DELIVERY

3125 KVA — 2500 KW 80% P.F. General Electric, 3 phase, 60 cycle, 2300 volt, 3600 RPM condensing turbine-generator unit, 180-200# I.S.P., 500° T.T., equipped with surface condenser, panels and instruments.

Excellent condition—a complete installation.

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

1875 KVA G.E. condensing 175-200 lb. pressure, 500° T.T., 6600 volts, 3600 RPM complete with condenser.

937½ KVA G.E. automatic extraction condensing, 175 lb. pressure, 125°F. superheat, 15 lb. gauge, 2300 volts, 3600 RPM—complete.

625 KVA G.E. condensing 200 lb. pressure, 2300 volts, 3600 RPM complete with condenser and auxiliaries.

375 KVA G.E. condensing 150-200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with surface condenser and auxiliaries.

375 KVA (2) G.E. non-condensing, 150-175 lb. pressure, 5 lb. back pressure, 2300 volts, 3600 RPM each complete with direct connected exciter.

125 KVA G.E. non-condensing, 110-125 lb. pressure, 0-10 lb. back pressure, 240 volts, 3600 RPM complete with switchboard.

ROTARY CONVERTERS

1500 KW Westinghouse synchronous 250 volts, direct current—6 phase, 60 cycle alternating current, 514 RPM

750 KW G.E. synchronous, 600 volts direct current, 6 phase, 60 cycle alternating current, 1200 RPM.

330 KW G.E. synchronous, 600 volt direct current, 6 phase 60 cycle alternating current, 1200 RPM with 2300 to 408 volt transformers.

ENGINE-GENERATOR UNITS

Direct Current

1000 KW Westinghouse, 250 volts, 514 RPM generator direct connected through reduction gear to Westinghouse condensing turbine, 150-200 lb. pressure, equipped surface condenser.

400 KW G.E. 125 volts, 165 RPM generator direct connected to a 26" x 28" Elliott Ridgeway Unaflow non-condensing engine.

250 KW G.E., 250 v., 150 RPM generator dir. con. to a 20" x 28" Chuse non-releasing Corliss engine complete with switchboard.

125 KW Elliott 125 volts, 250 RPM direct current generator, direct connected Elliott automatic engine.

75 KW 125 volt, 1800 RPM Westinghouse direct current non-condensing turbine-generator unit.

75 KW, 125 volt, 2400 RPM Allis Chalmers-Terry non-condensing turbine-generator unit.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle

Alternating Current

625 KVA Allis (2), 440 volts, 150 RPM generator direct connected each to a 26" x 30" Hamilton Corliss engine, 125-150 lb. pressure.

312 KVA G.E. 2300/480 or 240 volt, 200 RPM generator direct connected to a Chuse 4-valve non-releasing Corliss engine.

600 KW Crocker-Wheeler, 250 volts, 300 RPM generator dir. con. to a 14" x 18" 4 cylinder Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 5 lb. back pressure, complete with switchboard.

312 KVA Elliot 400/2300/550 or 240 volts, 180 RPM generator direct connected to a 17" x 24" Elliott Unaflow non-condensing engine, 175 lb. pressure, 6 lb. back pressure.

250 KVA Westinghouse, 2300 or 480 volts, 200 RPM generator direct connected Nordberg Unaflow engine.

MOTORS

—3 phase, 60 cycle

900 HP G.E. 240 volts, 900 RPM synchronous.

500 HP 80% P.F., G.E., 240 volts, 900 RPM synchronous motor with direct connected exciter.

150 HP G.E. form K, 2200 volts, 580 RPM squirrel cage.

125 HP 80% P.F. Elec. Mchy, 440 volts, 400 RPM synchronous.

60 HP G.E. 220 volts, 900 RPM squirrel cage induction complete with starting compensator.

50 HP G.E. type I, form M, 2200 volts, 1200 RPM slip ring.

50 HP Allis-Chalmers, 440 volts, 600 RPM squirrel cage.

MOTOR GENERATOR SET

1500 KW Allis-Chalmers, 600 or 275 volt direct current generator direct connected to 2190 HP, 3 phase, 60 cycle, 4000/6600 volt, 300 RPM synchronous motor.

FREQUENCY CHANGER SETS

750 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts alternating current generator direct connected to 910 HP, 3 phase, 25 cycle, 2300 volt, 300 RPM synchronous motor.

1200 KVA General Electric, 3 phase, 60 cycle, 2400 volt alternating current generator direct connected to 1700 HP, 3 phase, 25 cycle, 2300 volt, 300 RPM synchronous motor.

SPECIALS

528 HP Heine A.S.M.E. code water tube boiler 350# pressure, 635°F., complete with stoker, superheaters —a complete installation—modern and practically new.

500 KVA G.E. 3 phase, 60 cycle, 2300 volt, 450 RPM belted generator.

165 KW Electric Machinery, 3 phase, 60 cycle, 2400 volt, 514 RPM belted generator.

22" x 48" Nordberg Corliss belted type engine, 150 to 175 lb. pressure, 100 RPM.

1—MODERN SLIGHTLY USED FAIRBANKS-MORSE FULL DIESEL UNIT CONSISTING OF:

350 HP, 5 cylinder, Model 32-D-14, vertical, 300 RPM engine direct connected to a 294 KVA, 3 phase, 60 cycle, 2400/550/440 or 240 volts alternating current generator.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO

WIRE OR PHONE
LONG DISTANCE 422

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS

6250 KVA G.E. 2300 V., cond.
4000 KVA Al. Chal. 2300 V. cond.
3750 KVA G. E. 2300 V. cond.
3125 KVA G.E. 4100/2300 V. cond.
2500 KVA G. E. 2300 V. cond.
2500 KVA Al. Chal. 440 V., cond.
1250 KVA (2) G. E. 2300 V. cond.
940 KVA Wghse. 6600 V. cond.
937 KVA G. E. Auto BLEEDER, 2300 V.
937 KVA G. E. 2300 V., cond.
937 KVA Al. Chal. 2300 V., 300#.
780 KVA Al. Chal. 2300 V., cond.
625 KVA Wghse. 2300 V., cond.
375 KVA G. E. 2300 V., cond.
312 KVA Elliott 480 V., cond.
250 KVA Al. Chal. 480 V. Auto BLEEDER.
150 KVA Wghse. 240 V. cond. (Non Cond.)
375 KVA G.E. 2300 V.
312 KVA C.W.—Moore, 450#, 240 V.
175 KVA Al. Chal.—Sturtevant 220 V.
75 KVA Al. Chal. 240 V.

BOILERS

749 HP (2) Edgemoor, 200#
728 HP Erie City, Ver. 200#
600 HP Connelly, 200#
522 HP Kidwell 207#, 3 drum
471 HP Erie City Ver., 160#
396 HP B. & W., 160#
259 HP (3) Wicks ver; 160# pulverizers.
250 HP Sterling, 160#
200 HP (2) Scotch Marine, 15#
Two 78" x 18' HRT 125#; pulverizers.
850 HP Babcock & Wilcox W. T. Boiler 250# with Riley Stoker

DIESEL ENGINE SETS

500 KVA Wghse.—Busch Sulzer
375 KVA Wghse.—Busch Sulzer
312 KVA G. E.—Anderson
312 KVA G. E.—McIntosh Sey.
200 KVA G. E.—Busch Sulzer
170 KVA F. M.—F. M. "VA"
140 KVA E. M.—Fairbanks Morse "V"
100 KVA C. W.—Bessemer
90 KVA (4) F. M.—F. M. "VA"
75 KVA Al. Chal.—International

BELTED

240 HP Fairbanks 35-E 6 cyl.
225 HP Chicago pneumatic 6 cyl.
80 HP (3) Fairbanks Style V. A.

GAS UNIT

44 KVA Caterpillar, 3-60-220 V.

SPECIAL

937 KVA G.E. 3-60-2300 V.; Surface Condenser, S.B., etc.
780 KVA Al. Chal. 3-60-2300 V.; Surface Condenser, etc.
259 HP (3) Wicks ver. 160#, pulverizers, coal handling equipment.

STEAM ENGINE SETS (A C)

500 KVA (2) G. E.—24 x 48 Bates Corliss.
490 KVA Wghse.—Hamilton Cross Comp.
420 KVA Wghse.—Erie Ball Cross comp.
375 KVA G. E.—22 x 27 Erie Ball, 4 V.
210 KVA G. E.—19 x 20 Skinner Unif.
150 KVA G. E.—16 x 15 Skinner Unif.
150 KVA G. E.—16 x 16 Skinner S. V.
125 KVA G. E.—12 x 21 Hamilton 4 V.
100 KVA G. E.—14 x 15 Skinner Unif.

PUMPS (MOTOR DRIVEN)

7500 GPM 80' head
4000 GPM 70' head
3600 GPM 85' head
3250 GPM 425' head
3000 GPM 100' head
3000 GPM (2) 65' head
1390 GPM 231' head
850 GPM 243' head
750 GPM Hill 231' head
350 GPM 720' head

STEAM ENGINE SETS (D C)

450 KW C. W. 250 V.—Nordberg Unif.
300 KW G. E.—Skinner Unif.
150 KW G. E.—Erie Ball 4 V.
100 KW G. E.—Erie Ball 4 V.

AIR COMPRESSORS

2200 CFM Nordberg 100#, Steam and Motor Driven
1080 CFM Nordberg 85#—Motor
500 CFM Ingersoll 100#—Motor
"Steam and Gas Driven"; all sizes

TRANSFORMERS

687 KVA (2) Maloney 13800-460 V.
500 KVA (3) Al. Chal. 33000-440 V.
500 KVA (2) G.E. 6600-2300 V.
500 KVA (2) G.E. 11900/6900-230/460
250 KVA (2) G. E. 6600-2300 V.
150 KVA (2) Furnace Type 6600-90
150 KVA (5) G.E. 2300-120/240
100 KVA (3) G.E. 13200-2300
100 KVA (3) Al. Chal. 22000-440 V.
100 KVA (2) G. E. 13200/6600-440/600 V. & small sizes.
3 Ph. Transformers
750 KVA Wagner 6600-2200 V.
500 KVA (4) G. E. 13200-120/208 V.
300 KVA (2) G. E. 13200-120/208 V.

BOILERS

1—528 HP Heine, 350 lb. with underfeed-stoker.
1—335 HP B & W Sectional Header Boilers, 200# pressure with superheaters, hand fired grates.
1—250 HP Casey-Hedges, 160 lb. pressure.
1—400 HP Wickes 3 drum low head boiler, 200# pressure with Chicago Spreader stoker. Installed 1932.
1—90,000# per hr. Badenhausen Boiler, 354# pressure.
1—357 HP HEINE with Riley Underfeed Stoker.
3—253 H.P. Vogt low head Boilers, 225# pressure, with oil burners, all auxiliaries. New in 1937.
2—300 HP Heine 175# pressure.
2—250 HP Wickes vertical boilers, powdered fuel.
6—600 HP 200# pressure O'Brien boilers.
1—394 HP Sterling Boiler chain grate stoker, 160# pressure.
1—585 HP Erie City vertical boiler 185# pressure, Type E stoker.
1—600 H.P. Union Iron Works 250# pressure Chair Grate Stoker new in 1936.
1—444 HP Union Iron Works Boiler, 225# pressure.
2—500 HP Edge Moor Boilers 200# pressure.
1—600 HP Union Iron Wks, 250# pressure boiler, chain grate stoker. New 1935.
1—624 H.P. Edgemoor Boiler, 200# pressure, underfeed stoker.
1—522 HP Sterling Boiler 200# pressure with Firite Stoker.
1—640 H.P. Heine Boiler, 199# pressure.
1—484 HP Springfield Boiler, 250# pressure oil burners.
2—309 HP Heine Marine boilers 225# pressure.
2—350 HP Stirling boilers with auxiliaries.
1—250 HP Heine boiler, underfeed stoker.
8—150 HP HRT Boilers, 150# pressure.
1—175 H.P. Water Tube Boiler, 160# pressure
4—1010 HP Heine watertube boilers 250# pressure.
1—400 HP Connolly Boiler 160# pressure with new tubes and auxiliaries.
4—72" x 18' HRT boilers including a 637 KVA General Electric condensing turbine. Complete plant.
1—150 HP HRT. 125# pressure, rebuilt and guaranteed.
56—50 HP Vertical Boilers 150# pressure all auxiliaries.

TURBINES

2—5000 KW Westinghouse 1800 RPM 3-60-2300 volts Surface Condenser all auxiliaries.
1—3200 KW Allis-Chalmers Condensing Turbine with auxiliaries.
1—2500 KW General Electric Condensing Turbine with auxiliaries.
15,000 KVA Westinghouse turbine, condenser.
1—1000 KW Westinghouse non-condensing turbines 350# pressure, 16# back pres.
1—937 KVA Allis-Chalmers Turbine.
1—625 KVA General Electric Turbine with jet condenser.
1—2000 KW Westinghouse Turbine with Surface Condenser and auxiliaries 3-60-440 volts.
1—300 HP Kerr Non-condensing 3600 RPM volts.
1—250 KVA Waite Turbine either condensing or non-condensing.
1—250 KVA General Electric non-condensing Turbine.
1—125 KW General Electric non-condensing Turbine.

ENGINE GENERATOR SETS

260 KVA Skinner uniflow engine.
1—750 KVA Rice & Sargent 3-60-600 volt engine generator.
2—200 KW 250 volt D.C. engine generator sets.
1—250 KVA Ridgeway engine generator set.
1—500 KVA Allis-Chalmers Corliss.
17 inch by 18 inch Skinner uniflow engine.
1—166 KVA Ames Uniflow engine generator set.
1—260 KVA Skinner uniflow engine.
2—625 KVA Bates Corliss engines.
1—7 ft. diameter by 175 ft. self supporting stack.

DIESEL ENGINES

2—200 KVA Fairbanks-Morse Full Diesel Engine Generator.
4—312 KVA MAN full diesel engine generators, solid injection, 4 cycle.
1—Busch Sulzer Full Diesel direct connected 1335 KW AC generator, rebuilt and guaranteed.
1,250 KVA Nelesco engine generator.

ENGINE GENERATOR SETS

1—625 KVA Nordberg Uniflow engine.
1—1000 KVA Skinner Uniflow engine.
400 KW Skinner Uniflow Engine Generator set.

MISCELLANEOUS

54,000 pound Cochrane hot process lime and water softener.
2500 HP Cochrane Open Feed Water Heater.
1—10' x 15' Illinois Forced Draft Chain Grate Stoker.
2—6 Retort Taylor Stokers. First-class condition.
1—8 retort Taylor, brand new stoker.
1—800 HP Hoppes open feedwater heater.

SEE Fletcher FIRST!

FLETCHER SALES CO.

325 Fincastle Building — LOUISVILLE, KY.

Wagner "Certified Rebuilt" Electrical Apparatus

QUICK SHIPMENT—Partial Listings—*Send for Complete Catalog!*

SQUIRREL CAGE MOTORS

3 Phase—60 Cycle—220 or 440 Volts

Qua.	HP	Mfr.	Type	Speed
1	300	Gen. Elec.	I-K	1800
1	250	G.E.	I-K	900
1	150	Gen. Elec.	I-K	1200
1	150	Gen. Elec.	IK-16	600
1	150	Cr. Wheeler	126Q	600
1	100	Allis Ch.	AN	1800
1	100	Gen. Elec. 2200 v.	IK-15	720
1	100	Allis Ch.	AN	600
3	100	Gen. Elec.	KT356	900
1	75	Gen. Elec.	KT337	1800
2	75	Allis Ch.	AN	720
1	75	Whse.	CCL	720
1	75	Gen. Elec.	I-K	600
1	60	Gen. Elec.	I-K	600
1	50	Lincoln	DH412	1200
1	50	Allis Ch.	AN	514
2	50	Gen. Elec.	KT336	1200
2	50	Gen. Elec.	KT542	900
1	50	Gen. Elec.	KT352	720
1	40	Wagner	19TRM	1200
1	40	Whse.	CX	600
1	40	Gen. Elec.	I-K	1200
3	40	Fair Morse b.b.	H12C	900
2	40	Allis Ch.	AR420	900
6	30	Allis Ch.	AN	1200
2	30	Gen. Elec.	KT532	900
1	30	Allis Ch. b.b.	AR220	900
2	30	Allis Ch.	AN	600
2	30	Gen. Elec.	KT336	720
2	25	Fair. Morse b.b.	H10C	3600
3	25	Gen. Elec.	KT322	1200
2	25	Gen. Elec.	KT326	900
2	25	Allis Ch.	AN	600

SLIP RING MOTORS

3 Phase—60 Cycle—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	500	Allis Ch. 2200 v.	ANY	514
1	400	G.E. 2200 v.	I-P	1200
1	300	G.E. 3 brg.	I-P	450
1	300	Burke	EMV	225
1	200	Whse.	CW	600
1	200	Cr. Wh. 3 brg.	SR26Q	720
2	150	Triumph	SR	514
1	100	G.E. 2200 v.	I-E13A	1800

SLIP RING MOTORS—Cont.

1	100	Gen. Elect.	I-M	600
1	75	Ideal 2200 v.	D120	1800
1	75	G.E. 2200 v.	I-E13	1800
1	75	Cr. Wheeler	8R22Q	900
1	75	Allis Ch.	ANY	600
1	75	Gen. Elec.	MT558	600
1	75	Whse. b.b.	CW662D	1200
2	60	Whse. 2200 v.	CW657	1800
5	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Al. Ch. b.b. 2200 v.	ARY	900
1	50	Allis Ch.	ANY	720
1	40	Northw'n.	HW35A	1200
6	40	Gen. Elec.	MT532	1200
2	40	G.E. 2200 v.	MT332	1200
1	40	Howell	SR	3600
1	40	Gen. Elec.	MT546	514
1	40	Fair. Morse b.b.	HV-M12C	900
1	35	F. Morse b.b.	HV-12B	1800
2	30	Northw'n. b.b.	HW404	1800
2	30	Allis Ch.	ANY	900
1	25	Gen. Elec.	I-M	1200
1	25	Allis Ch. b.b.	ARY	900
1	20	Whse.	CW	1200
1	20	Wagner	19TRS	900
1	20	Gen. Elec.	I-M	600

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
300	Whse.	ped.	220/440	900
250	G.E. 1 brg.	ATI	220/440	600
165	G.E. 3 brg.	TRB	220/440	450
100	Allis Ch.	.8PF	220/440	600

60 CYCLE A. C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
300	Whse.	ped.	240/480	900
250	Gen. Elec.	ATB	240/480	600
200	Gen. Elec.	TRB	240/480	720
125	Whse.	ped.	2300	600
100	Cr. Wheeler		240/480	600
50	Gen. Elec.	ATB	240/480	1200

HIGH FREQUENCY GENERATORS

2—300 KVA Crocker Wheeler 3 phase 180 cycles, 250 volts, 1800 RPM on base

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	G	250	1200
90	Gen. Elec.	RC36	250	1200
75	Whse.	SK	250	800
75	Whse.	ped.	125	750
55	Bullock	ped.	250	900
50	Northern	B	125	650
25	Gen. Elec.	DLC	125	900
20	Gen. Elec.	RC31B	125	900
16	Cr. Wheeler	CCD	125	415

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
250	Gen. Elec.	G	250	1200/1500
100	G. E. series	CO	230	570
100	Gen. Elec.	RC	230	1000
100	Gen. Elec.	DLC	230	575
75	Whse.	SK	230	600
50	National	CS	230	800
50	Northern	B	115	500/1000
50	Allis Ch.	interpole	230	900
35	Reliance	155T	230	1150
35	Northw'n.	B	115	1000
30	Bogue	interpole	230	700
30	Gen. Elec.	RC33	230	800
30	Reliance b.b.	185T	230	800/1600
25	Gen. Elec.	RC10	500	1500
25	Gen. Elec.	LC	230	1700
25	Roth	elevator	230	725
20	Fair. Morse	TR	230	325/1300
20	Whse.	SK	230	850

M-G SETS

250 KW Burke comp. interpole gen. DC 125V, coupled to 375 HP Burke synch. motor 3-60-220/440 V.—900 RPM.
100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125V. coupled to 150 HP I-K sq. cage motor 3-60-2300/4000 V.—1200 RPM.
90 KW Gen. Elec. RC 36 DC 250V. coupled to 135 H.P. G.E. sq. cage motor 3-60-220/440V.—1150 RPM.
30 KW Gen. Elec. RC 33 DC 250V. coupled to 45 H.P. G.E. KT 336 motor 3-60-220/440V.—1150 RPM.

CENTRIFUGAL PUMP

8" Cameron 1500 gpm @ 250 ft. head, on base coupled to 150 HP G.E. motor 3-60-220-v.-1800 RPM

ARTHUR WAGNER COMPANY

1436-38 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 7409

TURBO GENERATORS

1—1000 KW 3 phase 60 cycle 480 volt 3600 rpm General Electric non condensing with board
1—750 KW General Electric
1—500 KW General Electric
1—300 KW General Electric
1—400 KW Moore extraction type

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit breakers, etc. Please send us your inquiries. What have you for sale?

KEYSTONE POWER PLANT EQUIPMENT CO.

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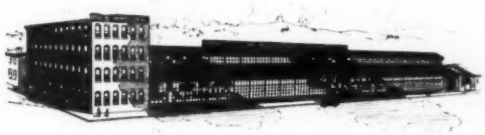

AT YOUR SERVICE

120,000 SQ. FT. OF WAREHOUSE SPACE . . .

. . . Housing our Complete Rebuilding Facilities . . . Also a wide range of Electric Motors and Power Plant Equipment

SPECIAL

3—General Electric, 4 bearing M.G. Sets, type CD, 1000 amp., 60 v. Generators coupled to Type TS, 90 HP, .9 P.F., 220/3/60/1200 Synchronous Motors.

2—Wilson, 4 bearing (Ball) M.G. Sets, 1500 amp., 60 V. coupled to 135 HP Continental, .9 P.F., 220/3/60/1200 Synchronous Motors.

All sets have starting compensators, circuit breakers and control panels.

THE GLOW ELECTRIC CO.

933-943 HARRIET ST. — Phone MA. 3024 — CINCINNATI, OHIO

Electrical Equipment In Stock Rebuilt and Guaranteed

230-VDC. CRANE & MILL MOTORS

(Series and Compound)

H.P.	Make	Type	R.P.M.
1—1	F. & H.	5½x3½	850
2—2	Shaw	Class B.E.	930
1—2½	G.F.	C.O.-2502	750
1—2½(new)	Reliance	T-224	1600
4—3	Shaw	B.E.	750
1—3½	G.E.	C.O.-2503	975
1—7/10	G.E.	M.D.-102	1025/800
1—7½	G.E.	C.O.-1805	700
1—10	C.W.	B.W.	650
1—20	G.E.(115-V)	C.O.-2504	850
2—20/30	G.E.	M.D.-104 (C.P.)	725/575
3—35	G.E.	C.O.-1809	850
2—30/45	G.E.	M.D.-104½(C.P.)	625/500
1—50	G.E.	C.O.-1810	725
2—55/85	G.E.	C.O.-1830	700/650
1—85	G.E.	C.O.-1811	550

(All Motors Are Series Wound Except Where Marked C. P. Compound)

220/440-VAC., 3-PH., 60-CY. MOTORS

(CRANE TYPE)

H.P.	Make	Type	R.P.M.
1—7½	G.E.	MTC-5952	855
1—7½	G.E.	MTC-5946	1200
1—11	F. & H.	HW-10-A	820
1—11	Westgshe	C.I.-452-A	1160
1—11	G.E.	ITC-5008	900
1—11	Louis Allı	Crane	1200
1—15	G.E.	ITC-5008	1200
1—15	G.E.	MTC-5300	1100
1—15	Electro. Dyn.	F.R.-1601	1145 (2-PH)
1—15	G.E.	M.Q.C.	1200 (2-PH)
1—22	G.E.	ITC-5009	1135
1—30	Westgshe	M.W.	1150
1—35	Westgshe	C.I.	720 (2-PH)
1—35	Westgshe	C.I.-885	950 (2-PH)
1—52	G.E.	I.T.C.-5013	600
1—50	Westgshe	C.I.-6440	870

(Can Supply Electric Brakes With Most Of These Motors)

SPECIAL:

(3)—EC&M Youngstown Limit Switches.
(1)—EC&M Magnet control. 230 VDC master controller, contactor and resistor.
(1)—Spring type magnet cable reel with rubber covered cable.

GENERAL PURPOSE 230-VDC MOTORS

H.P.	Make	Type	R.P.M.
2—2	Allis. Chal.	E-50	1750-SH.
1—3	G.E.	CD-55	1150-SH.
1—3	Reliance	T-224	3500-SH.
3—5	Westgshe	SK-40	850-SH.
2—5	Westgshe	SK-30	1100-Comp.
4—5	Westgshe	SK-30	1100-SH.
2—7½	Westgshe	SK-60	850-Comp.
1—7½	Westgshe	SK-40	1150-SH.
1—10	Westgshe	SK-50-L	1300-SH.
1—15	Allis. Chal.	Shunt	800
1—15	C.W.	Size 15-J	800-Comp.
1—15	G.E.	CD-75	1750-SH.
2—25	Westgshe	SK-160-L	1100-SH.
1—40	Reliance	RH-992	1200-Comp.
1—75	Westgshe	SK-160	850-Comp.

230-VDC. VARIABLE SPEED MOTORS

H.P.	Make	Type	R.P.M.
1—2	G.E.	RF	500/2000
1—3	G.E.	RLC-111	750/1500
—3½	G.E.	RLC-112	600/1800
1—5	Westgshe	SK-33	1150/1650
1—7½	Westgshe	SK-103	400/1600
1—8	Westgshe	SK-100L	300/1200
1—20	G.E.	RF-12	400/1200
1—25	Reliance	310-T	300/1200
1—70	Reliance	461-T	600/1200

(Auto. Control Panels With Most of These Motors)

220/440-VOLTS, 3-PHASE, 60-CYCLE MOTORS (GENERAL PURPOSE)

H.P.	Make	Type	R.P.M.
1—1½	G.E.	K.T.-180	1800/1200/900/600
2—3½	G.E.	K.T.-180	1800/1200/900/600

(Above With Special G.E. Drum Controls)

1—5	G.E.	K-254(vert)	1735
1—7½	Sprague	MT-181	1800 (S.R.)
2—7½	Louis Allis	OX-28	1740
1—7½	Westgshe	C.S.	1200
1—10/20	G.E.	KT-522-Y	600/1200
1—10	F.M.	OS-FW-324	1740
1—12½/25	Westgshe	C.S.	880/1730 (A.C.)
1—20	C.W.(B.B.)	ALS-404	1150 (A.C.)
1—20	G.E.	1	1200
1—25	Westgshe	C.S.	900
1—25	F.M.	H-12-B	900
2—25	F.M.	H-12-A	1200
1—25	G.E.	KF-405	1170
2—25	G.E.	KT-326	1200
1—35	F.M.	H-12-B	1200
1—35	G.E.	1-form-K	1800
1—50	G.E.	KT-346	870
1—75	Westgshe (S.R.)	C.W.-753-C	870 (A.C.)

(B. B. Ball Bearing; S R. Slip Ring; A. C. Automatic Control)

SPECIAL:

14—Master Electric Motors, Explosion Proof Fan Cooled, 2-HP., 1725-RPM. 220/400-V., 3-PH., 60 CY, Ball Bearing, with Mercury Clutch, Master Speed Ranger, Speeds 700-900-1060, 1260-1500-1780-2100-RPM.

T. B. MacCABE COMPANY

4306 CLARISSA ST. PHILADELPHIA 40 PA.

FOR IMMEDIATE DELIVERY

12 x 13; 11 x 11; 10 x 12 Empire Donkeys.
Motors, 5 to 1000 H.P.
No. 11S London; 21E Koering Cement Mixers.
450 Head Pumps; 90 to 500 gallons.
Foundry Compressor 8 x 8; IR 10 x 12.
IR 14 x 14; Holman 6¾ x 7; 2 cylinder.
Broom & Wade 10 x 12; 2 cylinder; Rand 14 x 9 x 12.
IR 19½ x 12 x 10; IR 4 x 4.

STEAM ENGINES

(with or without generators)

H.P.	Make	Cyl. Size	Flywheel	K.V.A.
750	Corliss	32x42	20'	
600	Corliss	24x36	17'	
600	Robb-Armstrong	21x39x24		500
	Robb-Armstrong	21x36x24		360
275	Twin City	18x42	14'	220
250	McEwen	12x16	6'	200
	Robb-Armstrong	12x18x14	6'	120
	Robb-Armstrong	11x17/14	6'	100

DIESELS

Make	H.P.	R.P.M.	K.V.A.
2—Campbell	675	225	520
2—Dominion Crossley	400	514	375
1—Kromhout	350	240	250
1—Electric Boat	550	225	
1—Polar Atlas	120	275	100
1—FM CO 2	100	450	75

HYDRO PLANTS

K.V.A.	Head	R.P.M.
450	600 ft.	
665	500 ft.	450

STEAM TURBINES

100—5000 KW

Motor Generators or Convertors

KVA	Volts	Cycle	Phase	dc	RPM
435	4000	60	3	600	870
435	4000	60	3	600	870
180	2200	60	2	125	580
436	13200	60	3	600	720
550	13000	60	3	600	720
					375
1500	12200	25	3	275	485
1500	12000	25	3	275	485
1287	12000	25 to 60 cycle			

Synchronous Motors or Condenser

125	2200	60	3	110	245
500	574	25	3	60	750
750	2200	60	3	100	
500	2300	60	3	20 pole 360	
5000	13200	25	3		300

120 KW 110—220 DC Turbine

VANCOUVER SALES & APPRAISALS, LTD.

VANCOUVER, B. C., CANADA

FAIRBANKS-MORSE DIESEL GENERATOR SET

120 H.P. Full Diesel Engine #676049, 2 cylinder, 2 cycle, type Y, Model VA, 257 RPM, 14" bore x 12" stroke.
Direct connected to:
90 K.V.A. 3 phase, 60 cycle, 2300 volts, F. & M. Alternator #167829, Frame D401, type D, with direct conn. exciter 7½ K. W. F. & M., 257 RPM, 125 volt, continuous duty. Can be seen running on original foundation.

IMMEDIATE DELIVERY

Aljon Electric Diesel Company
151-55 Washington St. Brooklyn, 1, N. Y.
Main 4-3804-5

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REBUILT & GUARANTEED STOCK
MOTORS, D.C. & A.C. TRANSFORMERS
MOTOR GENERATOR SETS
ROTARY CONVERTERS
SWITCHBOARDS BUILT TO ORDER

For Details, Write

JOHN D. CRAWBUCK CO.
710 Empire Bldg., Pittsburgh 22, Pa.

FOR SALE

2100 HP. Badenhausen, 425 lb. bent tube Boiler; ASME; heaters, pumps, comp. equip.

J. PARKER THOMPSON CO.
507 5th Ave. New York (17)
Murray Hill 2-5740-41.

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

3 PHASE, 60 Cycle, 220/400 V.

HP	Make	RPM	Type	Frame
7½	Gen. Elect.	1200	KT	952
10	Gen. Elect.	720	K	404
10	Gen. Elect.	900	KT	312
15	West.	1800	CS	
20	Gen. Elect.	900	KG	405
20	Armor	900	ball bearing	
20	Fairbanks Morse	900	ball bearing	
20	Fairbanks Morse	1200 600	two speed	
25	Westinghouse	900	CS	444
30	Armor 2-phase	720	ball bearing	
40	Westinghouse	1800	CS	
50	Gen. Elect.	1800	IK	
50	Westinghouse	900	CS	505
50	Westinghouse	900	CS	646A
50	West.	1800	CS	
60	Gen. Elect.	1800	I	form K
75	Gen. Elect.	1800	I	form K
75	Gen. Elect.	900	KT	552
100	Gen. Elect.	1800	I	form K
100	West.	1800	CS	
150	Gen. Elect.	1200	I	form K
150	Gen. Elect.	1200	I	form K

TRANSFORMERS

Amt.	Kva.	Make	Cycle	Voltages
3	25	Gen. Elect.	25	2300/115/230
3	50	Gen. Elect.	25	2300/115/230
3	75	Gen. Elect.	60	4600/230/460
3	100	Gen. Elect.	25	2300/115/230/460
2	150	Westinghouse	25	2300/115/230/460
3	200	Gen. Elect.	60	2300/230/460
3	250	Gen. Elect.	6	13,000/2300
3	250	Westinghouse	60	11500/460
2	333	Westinghouse	60	2300/230/460
3	500	Pittsburgh	25	11,000/220
4	833	Allis Chalmers	60	13,200/440
3	1000	Pittsburgh	60	2300/4600/230/460

SPECIAL

3—250 KVA. Westinghouse Transformers Type SL 11,500 volts Primary 460 volts. Secondary, 60 cycle 1 phase. Used less than 1 year.

Mine Slope Hoist

1—Connellsville Mfg. and Mine Supply Hoist storage capacity for 11,000 feet 1" Rope—Speed 900' per minute.
Motor—500 HP Gen. Elec. Mt. Slipring 3/60/2200/450 RPM. Complete with remote control, Herringbone reduction gears and demountable base and drum.
Write Wire Phone
Inspection can be made for 30 days in operation. This machine almost new.

MOTOR GENERATOR SETS

1—125 KW Ridgeway 250 V. DC. 1200 RPM Motor 3/440/60/1200 Complete.
1—100 KW Westinghouse Synchronous-Generator 250-275 V. DC—Motor 3/60/2300/900 RPM complete with panels.
1—150 KW Westinghouse Synchronous-Generator 250-275 V. DC. Motor 3/60/2300/900 RPM complete with panels.

3 PHASE, 25 CYCLE, 220/440 VOLTS

HP	Make	RPM	Type	Frame
5	Al. Chal.	720	AR	
5	Wagner	1450	Ball B.	Enclosed
7½	West.	750	CS	
7½	G.E.	1500	KT	181
10	G.E.	750	KT	312
10	West.	750	CS	
10	West.	1500	CS	
15	G.E.	1500	I	Form K
15	G.E.	750	KT	
15	West.	1500	CS	
20	West.	750	CS	
25	West.	750	CS	
50	G.E.	750	I	Form K
50	West.	750	CS	
75	G.E.	750	KT	357
75	G.E.	750	I	Form K
100	G.E.	300	I 17	Form K
150	G.E.	750	I	Form K
150	G.E.	750	I	Form K
200	West.	460	CS	2200 Volt
200	G.E.	750	I	Form K
225	Elec. Ma.	500	2200 V.	Synchron
1150	G.E.	375	2300 V.	Synchron
200	West.	235	CW	Slipring

Prices on Application

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/400 VOLTS

HP	Make	Speed	Type	Frame
10	Gen. Elect.	1800	MT	303
15	Gen. Elect.	1800	I	form M
20	Gen. Elect.	545	MT	332
20	Westinghouse	575	CW	648A
20	Westinghouse	575	CW	ball bearing
25	Westinghouse	690	CW	
30	Gen. Elect.	1800	MT	327
30	Gen. Elect.	1800	I	form M
40	Westinghouse	690	CW	748
40	Westinghouse	690	CW	748A
40	Westinghouse	690	CW	784A
40	Westinghouse	690	CW	748A
50	Westinghouse	900	CW	
60	Westinghouse	720	CW	2200 volt
75	Westinghouse	1800	CW	
500	Westinghouse	600	CW	

SPECIAL

2—500 HP. Gen. Elec. Motors, Type I, Form K, 3/60/440/900 RPM, with Starting Compensators.
1—500 HP. Gen. Elec. Motor, Type KTP, 3/60/440/1200 RPM with Starting Compensator.

2—1250 KVA Gen. Elec. Synchronous—motor 3/25/2200 750 RPM. direct connected to Generator 3/62½/440 V. Complete with exciters and panels.
1—200 KW General Electric 3 ph., 60 cy., 2300 V. direct connected to 290 HP. Gen. Elec. Synchronous Motor, 3 ph., 25 cy., 440 volt, 750 RPM. Complete with panels.

150 HP D.C. MOTOR
150 HP. Westinghouse Type SK, 180L, 230 V., 1100 RPM, Compound Interpole. Serial No. 2221504.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

CHICAGO ELECTRIC—GUARANTEED REBUILT EQUIPMENT

2—1500 KW MGS.
2—1500 KW Wtg. 250 d.c. dir. conn. 2250 hp. Syn. 360 rpm. 3-60-12000/2300 V.

MOTOR-GENERATOR SETS

KW	Make	DC volts	AC volts
1500	Wtg.	250	2300 SYN
1000	G.E.	600	4400/2200
1000	Wtg.	275	4160/2300
750	G.E.	275	440
300	Al. Ch.	600	2300 syn.
250	G.E.	600	
200	3-unit	80v. DC	250 v. DC
235	Westg.	110	2200
225	Ideal	115	2200
200	Westg.	250	440/2200
200	Elliott	115v.	220
150	Cr. Wh.	250	2300
150	Ideal	250	440
150	Rldg.	250	2300
100	G.E.	250	2200
100	Westg.	125	2200
100	Al. Ch.	125	440
100	Westg.	250	220/440/2200
90 HP	Westg.	110	75 Kva 2200 ac
75	G.E.	250	2200
75	G.E.	125	220
50	Al. Ch.	3-w	2200
50	G.E.	125	4000
50	Westg.	250	2300
15	G.E.	230	220
15	Ster.	240	220
7½	Jenny	balance set	

SLIP RING MOTORS

Qu.	HP	Make	Type	Speed
1	30	Wagner	BR	850
1	30	Westg.	HF10A	860
1	15 35	Westg.	CW654C	575/1150
1	30 15	G.E.	OMT336	1155/550
1	35	F. Misc. vert.	UVA	1800
1	35	G.E.	I-M 13	600
1	35	G.E.	I-M-13	600
1	40	G.E.	MT-int.	1200
1	40	Wagner	22TBR	1725
1	40	Westg.	CW	1160
1	40	Wagner	BR	850
1	40	Westg.	HF	690
1	50	Westg.	HF11AH	1180
1	50	G.E.	MT536	1200
1	50	Al. Ch.		1160
1	50	West.	HF	860
1	50	F.M.	HV	720
1	50	Westg.	CW752C	690

2—1500 KW M.G. SETS

2—1500 KW Westinghouse, interpole, 250 volts, D.C. generators, speed 360 RPM, with commutating interfield poles, connected to
2—2250 KVA Westinghouse synchronous motors, 3 phase, 60 cycle, 12000/2300 volts, 360 RPM, with DC and AC switchboard equipment, excellent condition, available immediately.

FREQUENCY CHANGER

1—1400 HP General Electric type ATI-24-1250M-300 Form C, 3 ph. 60 cy. 460 volt, 300 RPM, 1570 amps. 1250 KVA. 0.9 P.F. synchronous motor with amort. wdg., dir/conn. to 1000 KW General Electric types ATI-10-1250M-300, 3 ph. 25 cy. 450 volts, 300 RPM. 1570 amps. 1250 KVA. 0.8 P.F. A.C. generator with amort. wdg., with 33 KW G. E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

SLIP RING MOTORS

Qu.	HP	Make	Type	Speed
1	50	G.E.	I-M	685
1	50	Al. Ch.	ARY	690
1	50	G.E.	I-M	600
1	50	Wtg.	CW855	570
1	50	G.E.	MTC5342	565
1	50	Al. Ch.		720
1	60	Westg.	CW	600
3	75	Al. Ch.	ARY	900
1	75	Westg.	F	720
1	75	G.E.	M-12	600
1	75/94	N. West	HW	1800
1	100	G.E.	I	600
1	100	Al. Ch. 2200 v.		600
1	100	Westg. 2200	CW	600
1	100	Westg.	HF	230
1	100	Wtg. vert.	CW	1160
1	150	Westg.	CW	600
1	150	Al. Ch.		580
1	150	Westg. 2200	CW	375
1	200	G.E.	IE	1200
1	200	Howell	S	600
1	200	Westg.	CW	345
1	250	Al. Ch. 2200/400		600
1	250	G.E. Slipring vert.		1200
1	300	G.E. Slipring	I-M2200	514
1	300	G.E., 3-brg.	MT-410	450
1	300	G.E. with outboard brg.	I-P	450
1	350	G.E.	MT-432-V	300
1	350	Allis C.		360

VARIABLE SPEED MOTORS

230 Volt D. C.

HP	Make	Type	Speed
1½	Cr. Wh.	CM	925/1210
2	G.E.	RC4	600/1000
3	Gen. Elec.	CD	1050/1700
4	Sprague	C	800/1400
5	Burke	AM12	500/1500
5	Burke	Wam12	960/1950
7½	Reliance	46T	875/1200
12½	G.E.	C	700/1400
20	G.E.	RF12	500/1500
20	G.E.	RLC	500/1500
20	G.E.	RC11	500/1500
25	G.E.	DLC	500/1000
35	Wtg.	SK140	500/1500
40	G.E.	LC	825/2000
40	Chandysn.		250/1500
50	Gen. Elec.	RC14	500/1500
50	G.E. Sprague	C	575/1000
50	Westinghouse	SK	500/1000
60	Electro Dyn.		450/900
90	Westinghouse	SK	575/1150
35 100	G.E.	CD165	425/850
100	Gen. Elec.	CD147	450/1150
100	Gen. Elec.		1100/1800

ROTARY

500 KW syn. rotary converter, 250/275 volts DC. with transfs. & switchgear.

BOILERS

100—HP Scotch Marine 100#
2—500 HP B & W 200# ASME
2—550 HP Edgemore 175#
2—300 HP Keeler 175#
1—516 HP B & W 20#, stoker
2—250 HP Union, Taylor stoker
2—240 HP Almy 180#
3—308 HP Heine ASME 180#
2—200 HP Scotch Marine 165#

A. C. GENERATORS

KVA	Make	Volts	Speed
60	F. Morse	2200	300
175	Westg.	2200	900
200	G.E.	240	720
200	Westg.	2400	600
210	G.E.	2300	200

SQUIRREL CAGE

2	75	G.E.	KT	2200	900
2	75	G.E.	KT		780
1	75	UG	CCL		690
1	75	Wtg.	2200	CS	690
1	75	Al. Ch.		AN	680
5	75	G.E.			600
2	100	Al. Ch. 2200 v.			1800
3	100	Westg., 2200/220/440		CS	1200
1	100	West. El.		KT	900
1	100	G.E., 2200 v.		IK	900
1	100	Al. Ch., 2200 v.			450
2	125	G. E. 2200 v.		KT547	1800
1	125	G.E.		K	1800
4	125	G.E.		KT	720
1	150	Westg., 2200 v.		CS	1716
1	150	Al. Ch.			1200
1	150	G.E.		K-558	900
1	150	Westg., 2200 v.		CS	1800
2	150	G.E.		I-K	780
1	150	G.E.		IK	600
2	150	Westg.		CCL	495
1	200	Westg.		CS	3600
3	200	F. Morse, B.B.			1800
1	200	G.E., 2200 v.		KT	1800
1	200	G.E.		IK	1200
1	200	G.E.		IK	600
1	200	Westg.		CS	600
1	225	G.E., 4160 v.		FT	3600
1	225	G.E., 2200		I-E	1800
4	250	Fair. M.B.B., 2200 v.			1800
1	250	Ideal		A	1200
1	250	F. Morse B.B.		3-brg.	900
2	400	G.E. 2200 v.		I-K	1800
1	700	G.E., 2200, drip-proof constr.		KF	1800

CHICAGO ELECTRIC CO.

1320 W. GERMAK RD. CANAL 2900

CHICAGO 8, ILL.

1—400 HP Westinghouse, type CW, 3 ph. 60 cy, 440V, 450 RPM slip ring motor

1—250 HP General Electric, 3 ph, 60 cy, 440V, 1-17 400 RPM

1—150 HP Electric Mach. syn. motor, 125 KVA, 3-60-220V, 1200 RPM

1—150 HP General Electric, 3-60-440V frames 17A 360 RPM slip ring

1—150 HP Westinghouse, 2 ph, 60 cy, 440V frame 1000, CW. 390 RPM slip ring

4—100 HP General Electric, 3-60-440V, 495 RPM, MT 562 slip ring

2—100 HP General Electric type I, form K, 3-60-220V 575 RPM

50 KW Westinghouse, 125/250 V, type SK, frame 160, 3 wire generator direct connected to a 100 HP General Electric, type KT356, 900 RPM, 3 PH, 60 CY, 220 V motor on fabricated base.

1—100 HP Westinghouse, type CCL, 3 ph, 60 cy, 2200V, 1750 RPM, Squirrel Cage

1—100 HP Allis-Chalmers, type ANY, 3 ph, 60 cy, 220V, 690 RPM slip ring

1—100 HP General Electric, 3 ph, 60 cy, 4000V, 720 RPM syn., type TS with direct connected exciter

2—100 HP Crocker Wheeler, size 2AQ, 3 ph, 60 cy, 440V, 385 RPM slip ring

1—100 HP Westinghouse, type CS, 3 ph, 60 cy, 440V, 1750 RPM sq. cage

2—75 HP 300 foot head Pumps: 2200V Fairbanks-Morse, 1800 RPM 3 ph, 60 cy, slip ring motors direct connected to 500 GPM 3 stage

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V 450 RPM slip ring

1—75 HP Fairbanks-Morse, type H, frame 165C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage

1—75 HP Lincoln, type IQ, 2 ph, 60 cy, 440V, 600 RPM Squirrel Cage

1—75 HP Allis-Chalmers, 3 ph, 60 cy, 440V, 600 RPM slip ring

1—75 HP General Electric, 3 ph, 60 cy, 440V, 600 RPM, MT558 slip ring

1—75 HP Western Elec. type I, 3-60-440V, 690 RPM

2—75 HP Allis Chalmers, 3 ph, 60 cy, 440V, 860 RPM slip ring

1—60 HP Lincoln 3-60-220V frame IKM, Sq. Cage, 900 RPM

1—60 HP General Electric, 3-60-440V, 720 RPM, type I, form K

1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring

1—60 HP Westinghouse, 3 ph, 60 cy, 220V, 1160 RPM, type CS-644C

1—50 HP Wagner (Fynn Weichsel) 3-60-440V, 1200 RPM

1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring

2—G.E. factory built syn. M-G sets 230 KW, 125V, 600RPM generator driven by 335HP, 4600V syn. motor complete with starting equipment and panels.

1—50 HP Triumph 3-60-440V, type C12, 1150 RPM, slip ring, rotor & stator rewound

1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring

1—50 HP Howell 3-60-440V, 870 RPM, type SCBB ball bearing Sq. Cage

1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage

2—50 HP Allis-Chalmers 3-60-440V, 690 RPM slip ring

1—50 HP General Electric 3-60-440V, 690 RPM, MTS 46, slip ring

1—50 HP Ideal 3-60-440V, 580 RPM, type AV, slip ring

1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage

1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage

1—50 HP General Electric 3-60-440V, 490 RPM, type I-M, slip ring

1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage

1—50 HP Allis-Chalmers, 3 ph, 60 cy, 220V, 1160 RPM, type AR-220D

1—50 HP Howell, 3 ph, 60 cy, 440V, 1165 RPM, type SC50-4, ball bearing

1—50 HP Allis-Chalmers, 3 ph, 60 cy, 550V, 860 RPM sq. cage

1—50 HP General Electric, type I-M, 3 ph, 60 cy, 440V, 720 RPM slip ring

1—45 KVA Fairbanks Morse, 3 ph, 60 cy, 220V, 1200 RPM alternator

2—30 HP Fairbanks-Morse, 3 ph, 60 cy, 2220V, 3600 RPM, type HO, frame 12B ball bearing

We have a stock of 3000 motors from 1 HP to 50 HP in AC and DC. We have a very large stock of air circuit breakers up to 12000 amp.

2—175 HP, 230V, DC Westinghouse, type SK, 150 to 550 RPM

1—100 HP General Electric, type CD, fr. 123, 230V, 1200 RPM

1—60 HP Westinghouse, type SK140L, 115V, 1150 RPM vertical

1—50 HP Westinghouse, type SK, fr. 160, 230V, 565 RPM

1—50 HP Westinghouse SK200, 230V, 250/900 RPM

1—DC Generator 45KW Bullock, 120V, 375A, 900 RPM

2—40 HP C & C 230V, 250/1000 (planer)

2—40 HP, G. E., 3 ph, 60 cy, 440V, 435 RPM, type 1-13A

25 CYCLE MOTORS

1—50 HP Westinghouse 3-25 cy-440V, 720 RPM, type MS, Sq. Cage

1—50 HP General Electric, 3-25 cy-440V, 700 RPM, type I-M, slip ring

1—40 HP Westinghouse 3-25 cy-440V, 730 RPM, type CI, frame 753A slip ring crane

1—35 HP Allis-Chalmers 3-25 cy-440V, 720 RPM, slip ring

1—30 HP Westinghouse 3-25 cy-440V, 720 RPM, CS. Sq. Cage

The Wente Electric Co.,

Hamilton, Ohio

REBUILT MOTORS & GENERATORS SINCE 1906

STEAM PUMPING ENGINES

1—**Snow** 6 mgd. C&FW Cr. Com. Opp. Type Cond. 20-40x14¾x36, with waterworks type cond.

1—**Allis-Chal.** 4 mgd. cr. com. cond. Size 12x28x13x24. Fine cond.

PUMP VALVES

Birch Valves for all types of of reciprocating pumps.

LARGE GATE VALVES

1—20" **Rensselaer** #13 Iron Body Bronze Mounted Hub End Gate Valve with 16" Iron Brass Lined Hydl. Cyl. with indicating Rod and Eyebolt, 100#

1—20" **Crane** 125# Flanged Hand Wheel operating Gate Valve.

BIRCH MANUFACTURING COMPANY

1523 Sedgwick St. Chicago, Ill.

GOOD VALUES ALWAYS

200 KVA 257 rpm Engine type Alternator.
80 and 150 HP 125/150 lb. HRT Boilers.
80 HP Vertical 125 lb. steam Boilers.
2500 KVA 2300 volt Condensing Turbine.
500 KW Uniflows, 1 each A.C. and D.C.
180 & 270 HP Worthington 2300 V. Diesel Gens.
30 Ton Plymouth Std. Gauge Diesel Locomotive.
1¼ Yd. P&H and Osgood Gas Cranes & Shovels.
350 HP Modern Fairbanks 2300 V Diesel Gen.
2—250 HP 1800 rpm Slip Ring Motors, 2300V.
Several small steam Engine Units.

Mississippi Valley Equipment Co.

507 Locust St. St. Louis 1, Mo.

A. C. GENERATORS

10—62.5 KVA General Elec. 220/127 Volts Type ATI, 3 ph. 60 cyc. 80% P.F. 1200 R.P.M. Revolving Field with Exciter.
8—37.5 KVA General Elec. 220/127 Volts Type ATI 3 ph. 80% P.F. 1200 RPM Revolving Field with Exciter.
5—25 KVA General Elec. 220/127 Volts 3 ph. Type ATI, 80% P.F. 1200 RPM Revolving Field with Exciter.
10—18.75 KVA General Elec. Type ASI, 120/240 Volts, 1 ph. 1200 RPM, 80% P.F. Revolving Field with Exciter.

WURTH ELECTRIC MOTOR CO.

Motors, Generators, Alternators, Frequency Changers

141 GRAND STREET NEW YORK CITY
Tel. CAnal 6-6138

FOR SALE

2—500 HP Taylor Underfeed Stokers—Complete
2—250 HP & 130 HP HRT Boilers; ASME Code
1—3' Symons Cone Crusher—10 HP Gas Boiler
1—625 HP, 200#, ASME Boiler & Stoker
1—400 KW, 250 V. DC Gen. D/C Unaflow Eng.
1—30 Ton, 40' Span, O.E.T. Crane
1—250 & 168 KW AC Gens. D/C Unaflow Engs.
1—28 KVA AC Diesel Engine—Generator Set

H. & P. MACHINERY CO., St. Louis, 6719 Etzel

DIESEL ENGINES

Large selection—All sizes and types. Generator units, marine engines, gasoline engines, auxiliaries—also boilers, steam engines, turbo generators.

Complete Information on Request

A. G. SCHOONMAKER COMPANY
44 Church Street New York, N. Y.
Phone—Worth 2-0455

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

75 KVA Ridgway A.C. Generator 3/60/480 Volts—90 Amps. Direct connected to 12 x 14 R.H. Ridgway Engine Side Crank—Single Valve—277 RPM—Complete with Belted Exciter—Generator Panel—Outfit late Type —85% New.

ARTHUR S. PARTRIDGE

415 Pine St. Louis

FOR SALE BY OWNER

Power Plant Equipment

BOILERS and STOKERS

1—520 H.P. Cross Drum, straight tube, sectional header — 200# pressure water tube boiler, Bituminous chain grate 200% rating Stoker. All fixtures, soot blowers, etc. Insured till Oct. 1944 for 200#. Other boilers from 150 to 1200 H.P.

1—183 H.P. 150# Bigelow Boiler

ENGINES

6—7 x 6 Vertical, totally enclosed, Troy engines. 25 H.P. at 300 R.P.M. 40 H.P. at 400 R.P.M.—self-oiling Number of steam pumps, duplex and single acting from 3 x 2 x 3 up to 20 x 12 x 15. Some of these are new.

TURBO GENERATORS from 500 to 15000 K.W.

1—500 KW 200# pressure 15# KW. hour rate G.E. exciter on shaft, complete with condenser and Panels.

Diamond Soot Blowers, 38 sets, 2" x 2½" valve in head

Transformers up to 5000 Kva.—3—2500 Kva.—9—300 Kva, 3—500 Kva. Number of smaller sizes.

Assortment of G.E. Flow Meters complete with boards, instruments, regulators and foxboro recorders.

Also have in stock oil circuit breakers up to 3,000 amps. and 74,000 volts—disconnect switches up to 6000 amps.

Stock of 5,000 current and potential transformers of all sizes, all kinds of relays, overload, underload, etc.

We also buy complete plants outright. What have you for sale?

HOWE BROTHERS

324-328 Pearl St. New York, N. Y.
Telephone Nos. Worth 2-2708—2709—2710

PIPE

CUT TO SKETCH ⅛ to 24"

METROPOLITAN
PLUMBING SUPPLY CO., INC.
INDUSTRIAL AND MARINE SUPPLIES
Large SURPLUS STOCK
STEEL-WROUGHT IRON-CAST IRON
BRASS-COPPER-CEMENT LINED PIPE
Power Plant Valves & Engineering Specialties - Jenkins - Fairbanks & Sarco Valves
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FLANGED VALVES & FITTINGS

HIGH PRESSURE-BOILERS

"New and Used — NOT Abused"!

JOE SULLIVAN CO.
911 N. Second Ave. Maywood, Ill.
Maywood 446

Reconditioned Motors, Generators, Control Equipment, etc.
Send for 32 page stock list.
Electric Apparatus Repair Company
Specialists on Rebuilding Motors. Generators and Controls.
1410 No. 6th St., PHILA., PA.

L. J. LAND AND COMPANY

D. C. Motors & Generators

Partial List Only!

230 VOLT DC MOTORS

H.P.	Make	Speed
150	West.	600
60	El. Dynam.	900
60	Roth	600
60	G.E.	480/1100 (2)
50	West.	550/1100
50	Cr. Wh.	700 (2)
50	G.E.	850
45	Diehl	850/1020
40	El. Dy.	1200
40	Reliance	400/1500
40	Cr. Wh.	915
35	West.	1150
25	Diehl	850/1020
25	G.E.	1150
25	G.E.	575
20	Cr. Wh.	1750
20	R & M	1160
20	G.E.	1150 (4)
20	West.	1150
20	G.E.	800 (2)
15	West.	1250
15	G.E.	1150 (3)
15	Cr. Wh.	900/1800
15	West.	850
10	West.	850 (2)
10	G.E.	825 (3)
10	G.E.	700
10	Al. Ch.	600/1800
10	West.	600/1200
10	G.E.	400/1600
10	West.	400/1200 (2)
9	G.E.	450/1800
8½	Diehl	900
8½	West.	850
8½	West.	350/1400
7½	Sturt.	3600
7½	Peerl's	1700
7½	West.	1450
7½	West.	1150 (2)
7½	G.E.	1150
7½	West.	975
7½	Al. Ch.	850
7½	El. Dy.	550/1650
7½	Watson	525/1150
7½	G.E.	400/1600
7½	West.	400/1600
7½	Al. Ch.	350/1050
7½	G.E.	300/1200
6	G.E.	400/1200
6	G.E.	450/1800 (2)
5½	West.	500/1500 (2)
5	West.	850
5	G.E.	900 (2)
5½	G.E.	400/1600
5	West.	1800
5	G.E.	1700
5	G.E.	1150 (2)
5	West.	1100
5	Al. Ch.	1150
5	Cont.	600/1800
5	West.	850
5	G.E.	850
5	Star	600/1200
5	El. Dy.	550/1650
5	G.E.	450/800
5	G.E.	600
5	G.E.	450/1350
5	West.	400/1200

230 VOLT DC MOTORS—Continued

5	El. Dy.	275/1100
4	G.E.	850/1150
3½	West.	850/1600
3	West.	1700
3	West.	1150 (6)
3	Roth	500/2000
3	G.E.	500/1500
2½	West.	480/1800

236 additional 230 volt D. C. Motors in stock as small as 1/20 H.P.

115 VOLT DC MOTORS

H.P.	Make	Speed
90	G.E.	900
20	West.	200/900
15	West.	1100
15	Cr. Wh.	800
10	L. Allis	3500
10	West.	850
10	El. Dy.	425/1275
7½	G.E.	850 (2)
6	Burke	650
5	Cr. Wh.	1875
5	West.	1100 (2)
5	Cr. Wh.	960

75 additional 110 volt Motors down to 1/6 H.P.

SPECIALS

10—15 H.P. 4-speed constant horsepower 600/900/1200/1800 RPM

5—15/10/7½/5 H.P. 4-speed motors 600/900/1200/ RPM

4 speed Magnetic Starters

General Electric
Westinghouse
Louis Allis.

BELTED AND MOTOR DRIVEN DC GENERATORS

200 KW	G.E.	250 volts
100 KW	West.	250 volts
96 KW	G.E.	60 volts
80 KW	El. Dy	250 volts
75 KW	West.	250 volts
60 KW	G.E.	600 volts
50 KW	West.	125 volts
48 K	West.	30 and 60 volts
45 KW	West.	250 volts
40 KW	Reliance	250 volts
30 KW	El. Dy.	600 volts
30 KW	G.E.	60 volts
40 KW	Cr. Wh.	125 volts
30 KW	West.	125 volts
25 KW	West.	125 volts
25 KW	G.E.	250 volts
20 KW	G.E.	125 volts
15 KW	West.	125 volts

43 additional Motor Generator Sets, 30 volts, 60 volts, 125 volts, 250 volts and 250 volts as small as ½ K.W.

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New York City's Largest Stock of Electrical Machines

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Reading, Penna.
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Office
York, Penna.
323 E. Market St.

SLIP RING MOTORS
3-PH., 60-CY.

HP	Volts	Make	Speed
900	2200	G.E.	900
800	2300	Whse	514
450	2300	G.E.	600
400	2300	Whse.	1200
350	220–440	G.E.	1800
300	2200	G.E.	1800
300	2200	Whse.	514
250	2300	G.E.	600
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–400	G.E.	600
150	440–220	G.E.	1800
150	440	G.E.	1800
150	550–2200	G.E.	1800
150	550	G.E.	720
125	440–220	G.E.	600
100	550–2200	G.E.	720
100	440–220	G.E.	1800
100	220–440	G.E.	720
100	220–440	G.E.	900
75	220–440	G.E.	900

SYNCHRONOUS MOTORS
3-PH., 60-CY.

600	2200	Whse.	900
350	440–220	G.E.	900
200	2300–4000	G.E.	1200
110	440	Whse.	900
100	2200–550	Al. Chal.	1800

PUMP
1—8" Dredge Pump 1880 GPM, 120' Morris Machine Works with direct connected Slip Ring Motor 125 HP, 600 RPM, G.E.

OUTDOOR OIL CIRCUIT BREAKER
1—New 400 Amp. Type FK, 136-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.

1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt

TRANSFORMERS
60 CYCLE

3—500 kva., G.E., type H, form KS, 13800-230/460
3—500 kva., Whse., 22000-2300.
3—350 kva., G.E., type H-KD 13200-4600.
3—333 kva., G.E., type H-KDD 2400-460/230.
3—250 kva., Whse., 13,800-460.
3—200 kva., G.E., type H 10000-600.
3—200 kva., G.E., H-KD 6600-2300/4000Y., 25 cy.
3—175 kva., G.E., 4000-480.
3—150 kva., G.E., type H-KDD 13200/2300.
3—150 kva., Al. Chal., type OISC 10400-2400.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—100 kva., G.E., type H 2400-240-480.
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3—100 kva., Whse., 22,000-2300.
2— 75 kva., G.E., type HK, 2300-230/115.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse., type SK, 13800-240/120.
3— 50 kva., Whse., 22,000-2300.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
550	440/220	G.E.	IK	900
400	440	G.E.	KTP	1200
400	2200	Whse.	C.S.	1800
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	600
250	2200	Whse.	CS	1200
250	440/220	G.E.	IK	1800
200	220/440	G.E.	IK	720
150	2200	Allis Ch.	AN	450
125	440/220	G.E.	KT	1800
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
60	550	G.E.	FT	3600
50	220/440	G.E.	K	1800

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1—500 kva., 900 r.p.m., 2209 V. Whse. Condenser.
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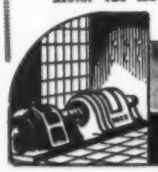
1—225 kva., 600 r.p.m., 2200-240 V., G.E.
1—110 kva., 900 r.p.m., 440 V., G.E.
1— 60 kva., 720 r.p.m., 240/480 V., G.E.
1— 25 kva., 3600 r.p.m., 220 V., G.E.



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1—1250 KW West Cond. 440 V.
1— 750 KW West Cond. 6600 V.
1— 600 KW GE Cond. 600 V.
1— 500 KW GE Cond. 600 V.
1— 500 KW GE Cond. 125 V. DC.
1— 400 KW West Non-Cond. 480 V.
1— 200 KW GE Cond. 2300 V.
1— 100 KW GE Cond. 600 V.
1— 75 KW GE N.C. 125 V. DC.

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1—175 HP GE 110#

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1—750 HP Heine 200# Stoker
3—318 HP Manning Type 170#
1—300 HP Heine 250# Stoker
1—250 HP 84" HRT 150#
1—150 HP HRT 150# Grates

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1— 825 CFM 100# Steam Driven
1— 600 CFM 500# Steam Driven
1— 386 CFM I.R. Steam Driven

Centrifugal Compressors
10000 CFM 33# Turbine Driven

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2—300 GPM 65' Hd. Motor Driven
1—1500 GPM Fire Pump Steam
1—1000 GPM Fire Pump Steam

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500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

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H.P	Make	Speed
200	G.E.	600
150	G.E.	860
147	West.	715
100	G.E	1200
100	West.	1750
100	West.	720
100	G.E. (BTA)	375/750
75	West.	870
50	West.	1200
50	G.E.	900
50	Al. Ch.	690
40	G.E.	900
35	Wagner	850
30	U. S.	3450 Vert.
30	West.	1750 Vert.
30	Al. Ch.	514
25	Wagner	1200
25	West.	1140
25	Diehl	865 (3)
25	G.E.	900
25	Wagner	720
20	G.E.	1750 (3)
20	G.E.	1200 (2)
20	Cr. Wh.	1200 (2)
20	Al. Ch.	900 (2)
20	Diehl	900 (3)
20	G.E.	720
20	West.	1720
15	Cr. Wh.	1700
15	G.E.	1200 (3)
15	Wagner	720
15	G.E.	600
10	G.E.	720 (5)
10	G.E.	3450
10	West.	1150

325 additional three phase Motors down to ¼ H.P.

TWO PHASE SQUIRREL CAGE MOTORS

H.P.	Make	Speed
75	Cr. Wh.	870
50	Linc.	900
50	G.E.	900
40	G.E.	900
40	Al. Ch.	900
35	Al. Ch.	900
30	West.	1200
25	G.E.	1200
20	West.	1150
15	G.E.	1200
15	F & M	900
10	G.E.	1200
10	G.E.	900
7½	G.E.	900
7½	G.E. (BQS)	600/1350
5	G.E.	900
5	Al. Ch.	1200

146 additional two phase Motors down to ¼ H.P.

2 & 3 PHASE SLIP RING

H.P.	Make	Speed
250	G.E.	600
200	West.	580
200	G.E.	495
125	West.	1175
125	Burke	580
112	G.E.	900
100	F. M.	690
75	West.	1170
75	Al. Ch.	575
64	G.E.	585
60	West.	1135
60	West.	290
50	Ideal Vert.	1740
50	G.E.	870 (2)
50	West.	850
40	Wagner	1150
40	F. M.	870 (2)
40	West.	870
40	Linc.	690
30	G.E.	870
30	G.E.	690
15/35	West.	6/1200 (5)
25/55	G.E.	6/1200
20/50	West.	6/1200
25	Al. Ch.	870 (2)
25	West.	850
25	G.E.	870 (2)
25	G.E.	720
25	West.	575
20	G.E.	870
20	West.	575

116 additional Slip Ring Motors in stock down to ½ H.P.

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10—15 H.P. 4-speed constant horsepower 600/900/1200/1800 RPM

5—15/10/7½/5 H.P. 4-speed motors 600/900/1200/1800 RPM

4 speed Magnetic Starters

General Electric
Westinghouse
Louis Allis.

SINGLE PHASE MOTORS

H.P.	Make	Speed
20	Wagner	1160
20	Cent.	1165
7½	Cent.	3500

38 additional single phase Motors.

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100 KVA West.	600
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25 KVA West.	1800

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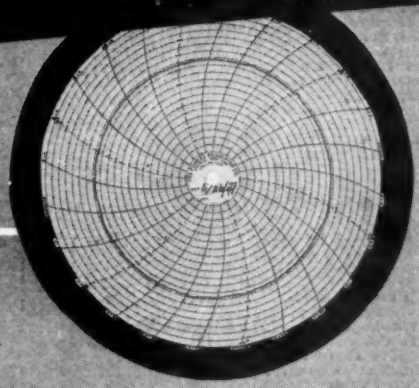

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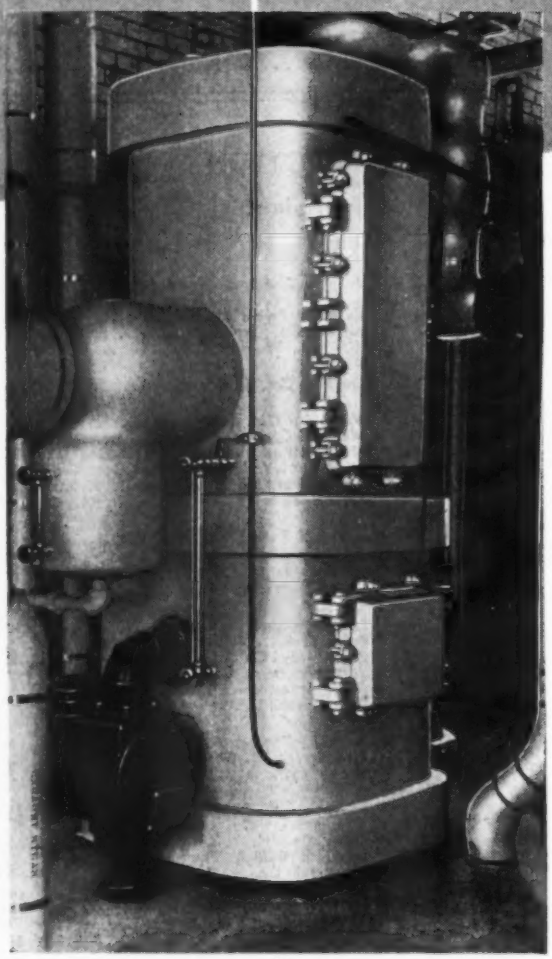

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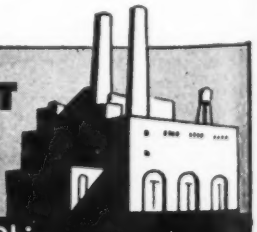

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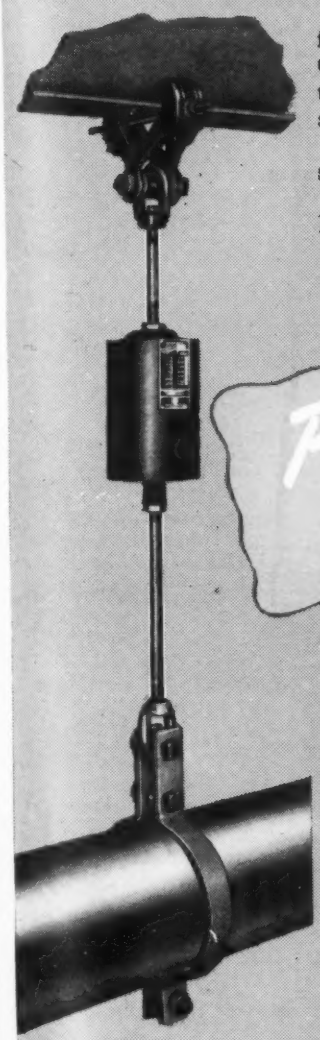

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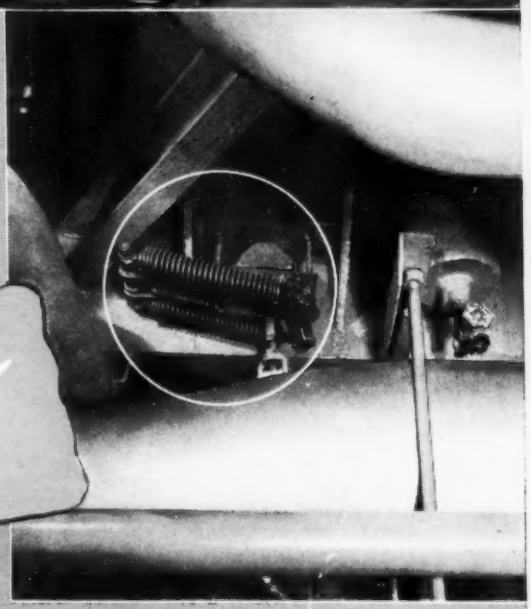

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